DOCUMENT RESUME

ED 410 120 SE 060 536

AUTHOR	Mullis, Ina V. S.; And Others
TITLE	Mathematics Achievement in the Primary School Years. IEA's Third International Mathematics and Science Study (TIMSS).
INSTITUTION	International Association for the Evaluation of Educational Achievement.; Boston Coll., Chestnut Hill, MA. Center for the Study of Testing, Evaluation, and Educational Policy.
SPONS AGENCY	National Center for Education Statistics (ED), Washington, DC.; National Science Foundation, Arlington, VA.
REPORT NO	ISBN-1-889938-04-1
PUB DATE	Jun 97
NOTE	244p.
AVAILABLE FROM	TIMSS International Study Center, Center for the Study of Testing, Evaluation, and Educational Policy, Campion Hall, School of Education, Boston College, Chestnut Hill, MA 02167; world wide web: http://wwwcsteep.bc.edu/timss; phone: 1-617-552-4521.
PUB TYPE	Reports - Evaluative (142)
EDRS PRICE	MF01/PC10 Plus Postage.
DESCRIPTORS	*Academic Achievement; Background; Elementary Education; Evaluation; Foreign Countries; Global Approach; *Mathematics Instruction; Student Attitudes
IDENTIFIERS	*Third International Mathematics and Science Study

ABSTRACT

The Third International Mathematics and Science Study (TIMSS) is the largest and most ambitious international comparative study designed to provide policy makers, educators, researchers, and practitioners with information about educational achievement and learning contexts. Data were collected from 45 countries in more than 30 different languages. Five grade levels were tested in the two subject areas, totaling more than half a million students tested around the world. The six content dimensions covered in the TIMSS mathematics tests given to the primary school students include: whole numbers; fractions and proportionality; measurement, estimation, and number sense; data representation, analysis, and probability; geometry; and patterns, relations, and functions. The results in this report describe students' mathematics achievement at both the third and fourth grade levels. About one quarter of the questions were in the free-response format requiring students to generate and write their answers. Chapters include: (1) "International Student Achievement in Mathematics"; (2) "Average Achievement in the Mathematics Content Areas"; (3) Performance on Items within Each Mathematics Content Area"; (4) "Students' Backgrounds and Attitudes towards Mathematics"; (5) "Teachers and Instruction". Appendices contain an overview of TIMSS procedures, the test-curriculum matching analysis, and percentiles and standard deviations of mathematics achievement. (JRH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

SE

Mathematics Achievement in the Primary School Years

TIMSS

ED 410 120

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

D.L. Kelly

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

060536

BEST COPY AVAILABLE

International Association for the Evaluation of
Educational Achievement

MATHEMATICS ACHIEVEMENT IN THE PRIMARY SCHOOL YEARS: IEA'S THIRD INTERNATIONAL MATHEMATICS AND SCIENCE STUDY (TIMSS)

Ina V.S. Mullis
Michael O. Martin
Albert E. Beaton
Eugenio J. Gonzalez
Dana L. Kelly
Teresa A. Smith

June 1997

TIMSS International Study Center
Boston College
Chestnut Hill, MA, USA

© 1997 International Association for the Evaluation of Educational Achievement (IEA).

Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study / by Ina V.S. Mullis, Michael O. Martin, Albert E. Beaton, Eugenio J. Gonzalez, Dana L. Kelly, and Teresa A. Smith

Publisher: Center for the Study of Testing, Evaluation, and Educational Policy, Boston College.

Library of Congress Catalog Card Number: 97-67235

ISBN 1-889938-04-1

For more information about TIMSS contact:

TIMSS International Study Center
Center for the Study of Testing, Evaluation, and Educational Policy
Campion Hall
School of Education
Boston College
Chestnut Hill, MA 02167
United States

For information on ordering this report, write the above address or call +1-617-552-4521.

This report also is available on the World Wide Web: http://wwwcsteep.bc.edu/timss

Funding for the international coordination of TIMSS is provided by the U.S. National Center for Education Statistics, the U.S. National Science Foundation, the IEA, and the Canadian government. Each participating country provides funding for the national implementation of TIMSS.

Boston College is an equal opportunity, affirmative action employer.

Printed and bound in the United States.

Contents

EXECUTIVE SUMMARY 1

INTRODUCTION 9

Which Countries Participated? 10

Table 1 TIMSS Countries Testing in the Primary Grades 11

Table 2 Information About the Grades Tested 13

What Was the Nature of the Mathematics Test? 14

How Do Country Characteristics Differ? 15

Table 3 Selected Demographic Characteristics of TIMSS Countries 16

Table 4 Public Expenditure on Education at Primary and Secondary Levels in TIMSS Countries 17

Figure 1 Centralization of Decision-Making Regarding Curriculum Syllabi 19

Figure 2 Centralization of Decision-Making Regarding Textbooks 20

Figure 3 Centralization of Decision-Making Regarding Examinations 21

CHAPTER 1: INTERNATIONAL STUDENT ACHIEVEMENT IN MATHEMATICS 23

What Are the Overall Differences in Mathematics Achievement? 23

Table 1.1 Distributions of Mathematics Achievement - Upper Grade (Fourth Grade) 24

Figure 1.1 Multiple Comparisons of Mathematics Achievement - Upper Grade (Fourth Grade) 25

Table 1.2 Distributions of Mathematics Achievement - Lower Grade (Third Grade) 28

Figure 1.2 Multiple Comparisons of Mathematics Achievement - Lower Grade (Third Grade) 29

What Are the Increases in Achievement Between the Lower and Upper Grades? 30

Table 1.3 Achievement Differences in Mathematics Between Lower and Upper Grades (Third and Fourth Grades) 31

What Are the Differences in Performance Compared to Three Marker Levels of International Mathematics Achievement? 32

Table 1.4 Percentages of Students Achieving International Marker Levels in Mathematics Upper Grade (Fourth Grade) 33

Table 1.5 Percentages of Students Achieving International Marker Levels in Mathematics Lower Grade (Third Grade) 34

What Are the Gender Differences in Mathematics Achievement? 35

Table 1.6 Gender Differences in Mathematics Achievement - Upper Grade (Fourth Grade) 36

Table 1.7 Gender Differences in Mathematics Achievement - Lower Grade (Third Grade) 37

What Are the Differences in Median Performance at Age 9? **38**

Table 1.8 Median Mathematics Achievement of 9-Year-Old Students 39

How Does Fourth-Grade Performance Compare with Eighth-Grade Performance? **40**

Figure 1.3 Mathematics Performance at Fourth and Eighth Grades Compared with the International Averages 41

Table 1.9 Increases in Mathematics Performance Between the Fourth and Eighth Grades 43

CHAPTER 2: AVERAGE ACHIEVEMENT IN THE MATHEMATICS CONTENT AREAS 45

How Does Achievement Differ Across Mathematics Content Areas? **45**

Table 2.1 Average Percent Correct by Mathematics Content Areas – Upper Grade (Fourth Grade) 47

Table 2.2 Average Percent Correct by Mathematics Content Areas – Lower Grade (Third Grade) 48

Table 2.3 Profiles of Relative Performance in Mathematics Content Areas – Lower and Upper Grades (Third and Fourth Grades) 51

What Are the Increases in Achievement Between the Lower and Upper Grades? **52**

Figure 2.1 Difference in Average Percent Correct Between Lower and Upper Grades (Third and Fourth Grades) Overall and in Mathematics Content Areas 54

What Are the Gender Differences in Achievement for the Content Areas? **56**

Table 2.4 Average Percent Correct for Boys and Girls by Mathematics Content Areas Upper Grade (Fourth Grade) 58

Table 2.5 Average Percent Correct for Boys and Girls by Mathematics Content Areas Lower Grade (Third Grade) 60

CHAPTER 3: PERFORMANCE ON ITEMS WITHIN EACH MATHEMATICS CONTENT AREA 63

What Have Students Learned About Whole Numbers? **63**

Table 3.1 Percent Correct for Example Item 1 – Lower and Upper Grades (Third and Fourth Grades) 66

Table 3.2 Percent Correct for Example Item 2 – Lower and Upper Grades (Third and Fourth Grades) 67

Table 3.3 Percent Correct for Example Item 3 – Lower and Upper Grades (Third and Fourth Grades) 68

Table 3.4 Percent Correct for Example Item 4 – Lower and Upper Grades (Third and Fourth Grades) 69

Table 3.5 Percent Correct for Example Item 5 – Lower and Upper Grades (Third and Fourth Grades) 70

Figure 3.1 International Difficulty Map for Whole Numbers Example Items 71

What Have Students Learned About Fractions and Proportionality? **72**

Table 3.6 Percent Correct for Example Item 6 – Lower and Upper Grades (Third and Fourth Grades) 74

Table 3.7 Percent Correct for Example Item 7 – Lower and Upper Grades (Third and Fourth Grades) 75

Table 3.8 Percent Correct for Example Item 8 – Lower and Upper Grades (Third and Fourth Grades) 76

Table 3.9 Percent Correct for Example Item 9 – Lower and Upper Grades (Third and Fourth Grades) 77

Table 3.10 Percent Correct for Example Item 10 – Lower and Upper Grades (Third and Fourth Grades) 78

Figure 3.2 International Difficulty Map for Fractions and Proportionality Example Items 80

What Have Students Learned About Measurement, Estimation, and Number Sense? 81

Table 3.11 Percent Correct for Example Item 11 – Lower and Upper Grades (Third and Fourth Grades) 83

Table 3.12 Percent Correct for Example Item 12 – Lower and Upper Grades (Third and Fourth Grades) 84

Table 3.13 Percent Correct for Example Item 13 – Lower and Upper Grades (Third and Fourth Grades) 85

Table 3.14 Percent Correct for Example Item 14 – Lower and Upper Grades (Third and Fourth Grades) 86

Table 3.15 Percent Correct for Example Item 15 – Lower and Upper Grades (Third and Fourth Grades) 87

Figure 3.3 International Difficulty Map for Measurement, Estimation, and Number Sense Example Items 88

What Have Students Learned About Data Representation, Analysis, and Probability? 89

Table 3.16 Percent Correct for Example Item 16 – Lower and Upper Grades (Third and Fourth Grades) 91

Table 3.17 Percent Correct for Example Item 17 – Lower and Upper Grades (Third and Fourth Grades) 92

Table 3.18 Percent Correct for Example Item 18 – Lower and Upper Grades (Third and Fourth Grades) 94

Table 3.19 Percent Correct for Example Item 19 – Lower and Upper Grades (Third and Fourth Grades) 95

Table 3.20 Percent Correct for Example Item 20 – Lower and Upper Grades (Third and Fourth Grades) 96

Figure 3.4 International Difficulty Map for Data Representation, Analysis, and Probability Example Items 97

What Have Students Learned About Geometry? 98

Table 3.21 Percent Correct for Example Item 21 – Lower and Upper Grades (Third and Fourth Grades) 99

Table 3.22 Percent Correct for Example Item 22 – Lower and Upper Grades (Third and Fourth Grades) 100

Table 3.23 Percent Correct for Example Item 23 – Lower and Upper Grades (Third and Fourth Grades) 101

Table 3.24 Percent Correct for Example Item 24 – Lower and Upper Grades (Third and Fourth Grades) 102

Table 3.25 Percent Correct for Example Item 25 – Lower and Upper Grades (Third and Fourth Grades) 103

Figure 3.5 International Difficulty Map for Geometry Example Items 104

What Have Students Learned About Patterns, Relations, and Functions? 105

Table 3.26 Percent Correct for Example Item 26 – Lower and Upper Grades (Third and Fourth Grades) 106

Table 3.27 Percent Correct for Example Item 27 – Lower and Upper Grades (Third and Fourth Grades) 107

Table 3.28 Percent Correct for Example Item 28 – Lower and Upper Grades (Third and Fourth Grades) 108

Table 3.29 Percent Correct for Example Item 29 – Lower and Upper Grades (Third and Fourth Grades) 109

Table 3.30 Percent Correct for Example Item 30 – Lower and Upper Grades (Third and Fourth Grades) 110

Figure 3.6 International Difficulty Map for Patterns, Relations, and Functions Example Items 111

CHAPTER 4: STUDENTS' BACKGROUNDS AND ATTITUDES TOWARDS MATHEMATICS 113

What Educational Resources Do Students Have in Their Homes? **113**

Table 4.1 Students' Reports on Educational Aids in the Home: Dictionary, Study Desk/Table, and Computer 114

Table 4.2 Students' Reports on the Number of Books in the Home 116

Table 4.3 Students' Reports on Frequency with Which They Speak the Language of the Test at Home 117

Table 4.4 Students' Reports on Whether or Not Their Parents Were Born in the Country 119

Table 4.5 Students' Reports on Whether or Not They Were Born in the Country 120

What Are the Academic Expectations of Students, Their Families, and Their Friends? **121**

Table 4.6 Students' Reports on Whether They Think That It Is Important to Do Various Activities 123

Table 4.7 Students' Reports on Whether Their Mothers Think That It Is Important to Do Various Activities 124

Table 4.8 Students' Reports on Whether Their Friends Think That It Is Important to Do Various Activities 125

How Do Students Spend Their Out-of-School Time During the School Week? **126**

Table 4.9 Students' Reports on the Amount of Out-of-School Time Spent Studying Mathematics or Doing Mathematics Homework on a Normal School Day 127

Table 4.10 Students' Reports on How They Spend Their Leisure Time on a Normal School Day 128

Table 4.11 Students' Reports on the Hours Spent Watching Television and Videos on a Normal School Day 130

How Do Students Perceive Success in Mathematics? **131**

Table 4.12 Students' Self-Perceptions About Usually Doing Well in Mathematics 132

Figure 4.1 Gender Differences In Students' Self-Perceptions About Usually Doing Well in Mathematics 133

Table 4.13 Students' Reports on Things Necessary to Do Well in Mathematics 135

What Are Students' Attitudes Towards Mathematics? **136**

Table 4.14 Students' Reports on How Much They Like Mathematics 137

Figure 4.2 Gender Differences in Liking Mathematics 138

Table 4.15 Students' Overall Attitudes Towards Mathematics 140

Figure 4.3 Gender Differences in Students' Overall Attitudes Towards Mathematics 141

CHAPTER 5: TEACHERS AND INSTRUCTION **143**

Who Delivers Mathematics Instruction? **144**

Table 5.1 Requirements for Certification Held by the Majority of Lower and Upper Grade Teachers 145

Table 5.2 Teachers' Reports on Their Age and Gender 146

Table 5.3 Teachers' Reports on Their Years of Teaching Experience 148

What Are Teachers' Perceptions About Mathematics? **149**

Figure 5.1 Percentage of Students Whose Mathematics Teachers Agree or Strongly Agree with Statements About the Nature of Mathematics and Mathematics Teaching 150

Figure 5.2 Percent of Students Whose Mathematics Teachers Think Particular Abilities Are Very Important for Students' Success in Mathematics in School 152

How Do Mathematics Teachers Spend Their School-Related Time? **154**

Table 5.4 Teachers' Reports on Average Number of Hours Mathematics Is Taught Weekly to Their Mathematics Classes 155

Figure 5.3 Percent of Students Who Are Taught Both Mathematics and Science by a Single Classroom Teacher 156

Table 5.5 Average Number of Hours Students' Teachers Spend on Various School-Related Activities Outside the Formal School Day During the School Week 157

Table 5.6 Teachers' Reports on How Often They Meet with Other Teachers in Their Subject Area to Discuss and Plan Curriculum or Teaching Approaches 158

How Are Mathematics Classes Organized? **159**

Figure 5.4 Teachers' Reports on What Factors Limit How They Teach Class 160

Table 5.7 Teachers' Reports on Average Size of Mathematics Class 163

Figure 5.5 Teachers' Reports About Classroom Organization During Mathematics Lessons 164

What Activities Do Students Do in Their Mathematics Lessons? **166**

Table 5.8 Teachers' Reports on Their Familiarity with National and Regional Mathematics Curriculum Guides 167

Table 5.9 Teachers' Reports on Their Main Sources of Written Information When Deciding Which Topics to Teach and How to Present a Topic 168

Figure 5.6 Teachers' Reports About Using a Textbook in Teaching Mathematics 169

Table 5.10 Teachers' Reports on How Often They Ask Students to Practice Computational Skills 170

Table 5.11 Teachers' Reports on How Often They Ask Students to Do Reasoning Tasks 172

Table 5.12 Students' Reports on Using Things from Everyday Life in Solving Mathematics Problems 173

How Are Calculators and Computers Used? **174**

Table 5.13 Students' Reports on Having a Calculator and Computer in the Home 175

Table 5.14 Teachers' Reports on Frequency of Students' Use of Calculators in Mathematics Class 176

Table 5.15 Teachers' Reports on Ways in Which Calculators Are Used At Least Once or Twice a Week 177

Table 5.16 Students' Reports on Frequency of Using Calculators in Mathematics Class 178

Table 5.17 Teachers' Reports on Frequency of Using Computers in Mathematics Class to Solve Exercises or Problems 179

Table 5.18 Students' Reports on Frequency of Using Computers in Mathematics Class 180

What Homework Are Students Assigned? **181**

Table 5.19 Teachers' Reports About the Amount of Mathematics Homework Assigned 182

Table 5.20 Teachers' Reports on Their Use of Students' Written Mathematics Homework 183

APPENDIX A: OVERVIEW OF TIMSS PROCEDURES: MATHEMATICS ACHIEVEMENT RESULTS FOR THIRD- AND FOURTH-GRADE STUDENTS **A-1**

History **A-1**

The Components of TIMSS **A-2**

Figure A.1 Countries Participating in Additional Components of TIMSS Testing A-4

Developing the TIMSS Mathematics Test **A-5**

Figure A.2 The Three Aspects and Major Categories of the Mathematics Framework A-7

Table A.1 Distribution of Mathematics Items by Content Reporting Category and Performance Category A-8

TIMSS Test Design **A-9**

Sample Implementation and Participation Rates **A-9**

Table A.2 Coverage of TIMSS Target Population A-11

Table A.3 Coverage of 9-Year-Old Students A-12

Table A.4 School Participation Rates and Sample Sizes – Upper Grade (Fourth Grade) A-13

Table A.5 Student Participation Rates and Samples Sizes – Upper Grade (Fourth Grade) A-14

Table A.6 School Participation Rates and Sample Sizes – Lower Grade (Third Grade) A-15

Table A.7 Student Participation Rates and Samples Sizes – Lower Grade (Third Grade A-16

Table A.8 Overall Participation Rates – Lower and Upper Grades (Third and Fourth Grades) A-17

Indicating Compliance with Sampling Guidelines in the Report **A-18**

Figure A.3 Countries Grouped for Reporting of Achievement According to Their Compliance With Guidelines for Sample Implementation and Participation Rates A-19

Data Collection **A-20**

Scoring the Free-Response Items A-21

Table A.9 TIMSS Within-Country Free-Response Coding Reliability Data for Population 1 Mathematics Items A-22

Test Reliability A-23

Data Processing A-23

Table A.10 Cronbach's Alpha Reliability Coefficients – TIMSS Mathematics Test Lower and Upper Grades (Third and Fourth Grades) A-24

IRT Scaling and Data Analysis A-25

Estimating the Link Between Fourth- and Eighth-Grade Performance A-26

Table A.11 Mathematics Performance at the Third, Fourth, Seventh, and Eighth Grades Based on the Population 2 (Seventh- and Eighth-Grade) Scale A-27

Estimating Sampling Error A-28

APPENDIX B: THE TEST-CURRICULUM MATCHING ANALYSIS B-1

Table B.1 Test-Curriculum Matching Analysis Results – Mathematics – Upper Grade (Fourth Grade) B-3

Table B.2 Test-Curriculum Matching Analysis Results – Mathematics – Lower Grade (Third Grade) B-4

Table B.3 Standard Errors for the Test-Curriculum Matching Analysis – Upper Grade (Fourth Grade) B-7

Table B.4 Standard Errors for the Test-Curriculum Matching Analysis – Lower Grade (Third Grade) B-8

APPENDIX C: PERCENTILES AND STANDARD DEVIATIONS OF MATHEMATICS ACHIEVEMENT C-1

Table C.1 Percentiles of Achievement in Mathematics – Upper Grade (Fourth Grade) C-2

Table C.2 Percentiles of Achievement in Mathematics – Lower Grade (Third Grade) C-3

Table C.3 Standard Deviations of Achievement in Mathematics – Upper Grade (Fourth Grade) C-4

Table C.4 Standard Deviations of Achievement in Mathematics – Lower Grade (Third Grade) C-5

APPENDIX D: ACKNOWLEDGMENTS D-1

Executive Summary

MATHEMATICS

Since its inception in 1959, the International Association for the Evaluation of Educational Achievement (IEA) has conducted a series of international comparative studies designed to provide policy makers, educators, researchers, and practitioners with information about educational achievement and learning contexts. The Third International Mathematics and Science Study (TIMSS) is the largest and most ambitious of these studies ever undertaken.

The scope and complexity of TIMSS is enormous. Forty-five countries collected data in more than 30 different languages. Five grade levels were tested in the two subject areas, totaling more than half a million students tested around the world. The success of TIMSS depended on a collaborative effort between the research centers in each country responsible for implementing the steps of the project and the network of centers responsible for managing the across-country tasks such as training country representatives in standardized procedures, selecting comparable samples of schools and students, and conducting the various steps required for data processing and analysis. Including the administrators in the approximately 15,000 schools involved, many thousands of individuals around the world were involved in the data collection effort. Most countries collected their data in May and June of 1995, although those countries on a southern hemisphere schedule tested in late 1994, which was the end of their school year.

Six content dimensions were covered in the TIMSS mathematics tests given to the primary-school students: whole numbers; fractions and proportionality; measurement, estimation, and number sense; data representation, analysis, and probability; geometry; and patterns, relations, and functions. About one-fourth of the questions were in the free-response format requiring students to generate and write their answers. These types of questions, some of which required extended responses, were allotted approximately one-third of the testing time. Chapter 3 of this report contains 30 example items illustrating the range of mathematics concepts and processes addressed by the TIMSS test.

Because the home, school, and national contexts within which education takes place can play important roles in how students learn mathematics, TIMSS collected extensive information about such background factors. The students who participated in TIMSS completed questionnaires about their home and school experiences related to learning mathematics. Also, teachers and school administrators completed questionnaires about instructional practices. System-level information was provided by each participating country.

TIMSS was conducted with attention to quality at every step of the way. Rigorous procedures were designed specifically to translate the tests, and numerous regional training sessions were held in data collection and scoring procedures. Quality control monitors observed testing sessions and sent reports back to the TIMSS International Study Center at Boston College. The samples of students selected for testing were scrutinized according to rigorous standards designed to prevent bias and ensure comparability. In this publication, the countries are grouped for reporting of achievement according to their compliance with the sampling guidelines and the level of their participation rates. Prior to analysis, the data from each country were subjected to exhaustive checks for adherence to the international formats as well as for within-country consistency and comparability across countries.

Of the five grade levels tested, the results provided in this report describe students' mathematics achievement at both the third and fourth grades. For most, but not all TIMSS countries, the two grades tested at the primary-school level represented the third and fourth years of formal schooling. Special emphasis is placed on the fourth-grade results, including selected information about students' background experiences and teachers' classroom practices in mathematics. Results are reported for the 26 countries that completed all of the steps on the schedule necessary to appear in this report.

The mathematics achievement results for students in the seventh and eighth grades were published in *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study*.[1] This report describes mathematics achievement in 41 countries, including results for major content areas, breakdowns by gender, example items, and results for selected background and attitudinal factors. Achievement results for students in their final year of secondary school will appear in a subsequent report.

The following sections summarize the major findings described in this report.

BEST COPY AVAILABLE

Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS). Chestnut Hill, MA: Boston College.* The science achievement results for seventh- and eighth-grade students are presented in a companion volume, Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

STUDENTS' MATHEMATICS ACHIEVEMENT

- Singapore and Korea were the top-performing countries at both the fourth and third grades. Japan and Hong Kong also performed very well at both grades, as did the Netherlands, the Czech Republic, and Austria. Lower-performing countries included Iran and Kuwait (see Tables 1.1 and 1.2; Figures 1.1 and 1.2).

- Perhaps the most striking finding was the large difference in average achievement between the top-performing and bottom-performing countries. Despite this large difference, when countries were ordered by average achievement there were only small or negligible differences in achievement between one country and the one with the next-lowest average achievement. In some sense, at both grades, the results provide a chain of overlapping performances, where most countries had average achievement similar to a cluster of other countries, but from the beginning to the end of the chain there were substantial differences. For example, at both grades, average achievement in Singapore and Korea was comparable to or even exceeded performance for 95% of the students in the lowest-performing countries.

- Many countries (9 of 12) that performed above the international average at the fourth grade also did so at the eighth grade. However, at the eighth grade, Ireland and Australia were about at the international average, while the United States was below it (see Figure 1.3).

- For most countries, gender differences in mathematics achievement were small or essentially non-existent. However, the direction of the few gender differences that did exist favored boys rather than girls. Similarly, within the mathematics content areas, there were few differences in performance between boys and girls, except in measurement, where the differences favored boys.

- Compared with their overall performance in mathematics, nearly all countries did relatively better in several content areas than they did in others. This is consistent with the idea of countries having different curricular emphases in mathematics.

- Even though students in the top-performing countries had very high achievement on many of the test questions, students generally had the most difficulty with the items in the content area of fractions and proportionality. The least difficult items involved whole number proportional reasoning and recognizing pictorial representations of fractions. In contrast, the more difficult items involved decimals, and students being asked to explain their reasoning.

- In data representation, students had some difficulty moving beyond a straight-forward reading of data in tables, charts, and graphs to actually using the information in calculations or to graphically represent the data. For example, students were asked to use data from a simple table to complete a bar graph. On average, 40% of the fourth graders and 23% of the third graders across countries drew the four bars to appropriate heights. There was, however, a very large range in performance from country to country. For example, about three-fourths or more of the fourth graders completed the bar graph in Hong Kong, Japan, Korea, and Singapore.

- Similarly, students were more likely to be able to recognize simple patterns and relationships than they were to determine the operations underlying the relationships. About half the students internationally provided an answer showing that they understood what to do to get the next number in a subtraction series, where the numbers were decreasing by 4. When given two columns of four numbers, only about one-fourth of the third graders and two-fifths of the fourth graders correctly determined that you needed to divide the number in Column A by 5 to obtain the number next to it in Column B.

STUDENTS' ATTITUDES TOWARDS MATHEMATICS

- Those students who reported either liking mathematics or liking it a lot generally had higher achievement than students who reported disliking it to some degree. The overwhelming majority of fourth graders in nearly every country indicated they liked mathematics to some degree, but not all students feel positive about this subject area. In Japan, Korea, and the Netherlands, more than one-quarter of the fourth-grade students reported disliking mathematics.

- In most countries, fourth graders of both genders were equally positive about liking mathematics. In Austria, Hong Kong, Japan, and the Netherlands, boys reported a significantly stronger liking of the subject area than did girls. However, girls reported liking mathematics better than did boys in Ireland and Scotland.

- Across countries, the majority of fourth graders agreed or strongly agreed that they did well in mathematics – a perception that did not always coincide with the comparisons of achievement across countries on the TIMSS test. Fourth-grade girls had lower self-perceptions than did boys in Austria, Hong Kong, Japan, the Netherlands, Singapore, and Slovenia.

HOME ENVIRONMENT

Home factors were strongly related to mathematics achievement in every country that participated in TIMSS.

- In many countries, fourth-grade students who reported having more educational resources in the home had higher mathematics achievement than those who reported little access to such resources. Strong positive relationships were found between mathematics achievement and having study aids in the home, including a dictionary, a computer, and a study desk/table for the student's own use.
- The number of books in the home can be an indicator of a home environment that values and provides general academic support. In nearly all countries, students reporting more than 100 books in the home had higher mathematics achievement than students reporting fewer books.
- In all but a few countries, 80% or more of the students responded that they always or almost always spoke the language they were tested in at home. Most certainly, these relatively high percentages reflect the effort expended by the participating countries to test in more than one language when necessary.
- In about half the countries, 80% or more of the fourth graders reported that both their parents were born in that country. Yet, the patterns in relation to mathematics achievement varied substantially from country to country. The fourth graders themselves generally were born in the country in which they were tested.
- For normal school days, fourth-grade students in most countries reported averaging approximately an hour (.7 to 1.3 of an hour) outside of school each day studying or doing homework in mathematics.
- Fourth-grade students in all countries also reported that they normally averaged an hour or two each school day watching television. In nearly all countries, students watching more than four hours of television per day had lower mathematics achievement than their classmates who watched less television.
- Besides watching television, students reported spending from one to two hours per school day playing or talking with friends and one to two hours per school day playing sports. (It should be noted, however, that the time spent in these activities is not additive because students can talk with their friends at sporting events or while watching TV, for example.)

INSTRUCTIONAL CONTEXTS AND PRACTICES

In comparison with the positive relationships observed between mathematics achievement and home factors, the relationships were less clear between achievement and various instructional variables, both within and across countries. The interaction among instructional variables can be extremely complex and merits further study.

- The qualifications required for teaching certification were relatively uniform across countries. Most countries reported that three or four years of post-secondary education were required, in either a university, a teacher training institution, or both. Almost all countries reported that teaching practice was a requirement, as was an examination or evaluation.

- In most countries, the mathematics teaching force was predominantly female. Ninety percent or more of the fourth-grade students had female teachers in the Czech Republic, Hungary, Israel, Latvia (LSS), Portugal, Scotland, and Slovenia.

- Teachers in most countries reported that mathematics classes typically meet for three or four hours a week, on average. However, more than 5 hours of weekly class time was reported for 50% or more of the fourth-grade students in the Netherlands, Portugal, Singapore, and Thailand. The data, however, revealed no clear pattern between the number of in-class instructional hours and mathematics achievement.

- In most countries, the challenge of catering to students of different academic abilities was the factor teachers mentioned most often as limiting how they teach their mathematics classes. Other limiting factors were a high student/teacher ratio, a shortage of equipment for use in instruction, and the burden of dealing with disruptive students.

- There was considerable variation in class size for the TIMSS countries, with the average ranging from 19 in Norway to 43 in Korea. In a number of countries, however, nearly all students (90% or more) were in classes of fewer than 30 students. At the other end of the spectrum, more than 90% of the students in Korea and Singapore were in classes with more than 30 students. The TIMSS data showed different patterns of mathematics achievement in relation to class size for different countries.

- Small-group work was used less frequently than other instructional approaches. Across countries, mathematics teachers reported that working together as a class with the teacher teaching the whole class, and having students work individually with assistance from the teacher were the most frequently used instructional approaches.

- Across countries, teachers for the majority of the students reported being fairly familiar with the official national and/or regional curriculum guides in mathematics. Teachers generally reported relying on these guides in deciding which topics to teach. The textbook was the major written source mathematics teachers used in deciding how to present a topic to their classes. In most participating countries, teachers reported using a textbook in teaching mathematics for 95% or more of the students.

- Relatively uniformly, the majority of students were asked both to practice computation and to do some type of reasoning tasks in most or every lesson. Using things from everyday life in solving mathematics problems most typically is done in some lessons.

- According to teachers in many of the TIMSS countries, most fourth-grade students never or hardly ever use calculators in their mathematics classes. The exceptions where there was at least weekly use of calculators for the majority of the students included Australia, England, and New Zealand. Both teachers and students agreed that the computer was almost never used in most students' mathematics lessons.

- Internationally, most fourth-grade students were assigned mathematics homework at least once or twice a week, if not more often. Most typically, for the majority of the students, the assignments were 30 minutes or less in length. In all participating countries, for at least 70% of the students, teachers reported at least sometimes, if not always, correcting homework assignments and returning those assignments to students. Yet, in general for the TIMSS countries, teachers reported that mathematics homework assignments contributed only rarely or sometimes to students' grades or marks.

Introduction

MATHEMATICS

The fact that skills in mathematics and science are so critical to economic progress in a technologically-based society has led countries to seek information about what their school-age populations know and can do in mathematics and science. There is interest in what concepts students understand, how well they can apply their knowledge to problem-solving situations, and whether they can communicate their understanding. Even more vital, countries desire to further their knowledge about what can be done to improve students' understanding of mathematical concepts, their ability to solve problems, and their attitudes towards learning.

The Third International Mathematics and Science Study (TIMSS) provided countries with a vehicle for investigating these issues while expanding their perspectives of what is possible beyond the confines of their national borders. It is the most ambitious and complex comparative education study in a series of such undertakings conducted during the past 37 years by the International Association for the Evaluation of Educational Achievement (IEA).[1] The main purpose of TIMSS was to focus on educational policies, practices, and outcomes in order to enhance mathematics and science learning within and across systems of education.

With its wealth of information covering more than half a million students at five grade levels in 15,000 schools and more than 40 countries around the world, TIMSS offers an unprecedented opportunity to examine similarities and differences in how mathematics and science education works and how well it works. The study used innovative testing approaches and collected extensive information about the contexts within which students learn mathematics and science.

The present report focuses on the mathematics achievement of primary-school students in 26 countries. Participants were to test students in the two grades with the largest proportion of 9-year-olds – the third and fourth grades in most countries. Special emphasis is placed on the fourth-grade results, including selected information about students' background and about classroom practices in teaching mathematics.

The countries that participated in TIMSS tested students in both mathematics and science. A companion report, *Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS)*,[2] presents corresponding results about students' science achievement in the lower grades.

---

[1] The previous IEA mathematics studies were conducted in 1964 and 1980-82, and the science studies in 1970-71 and 1983-84. For information about TIMSS procedures, see Appendix A.

[2] Martin, M.O., Mullis, I.V.S., Beaton, A.E., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1997). *Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

Forty-one countries, including those in this report, also tested the mathematics and science achievement of students in the two grades with the largest proportion of 13-year-olds (seventh and eighth grades in most countries). The initial achievement results for the seventh- and eighth-grade students already have been published in two companion volumes:[3]

- *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study.*
- *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study.*

Approximately 25 of the TIMSS participants also assessed the mathematics and science literacy of students in their final year of secondary education. Additionally, separate samples of students who had taken the relevant coursework were assessed in advanced mathematics and physics. In yet another effort, subsets of students, except the final-year students, also had the opportunity to participate in a "hands-on" performance assessment where they designed experiments and tested hypotheses. The achievement results for the final-year students and for the TIMSS performance assessment will be presented in forthcoming reports.

Together with the achievement tests, TIMSS administered a broad array of background questionnaires. The data collected from students, teachers, and school principals, as well as the system-level information collected from the participating countries, provide an abundance of information for further study and research. TIMSS data make it possible to examine differences in current levels of performance in relation to a wide variety of variables associated with the classroom, school, and national contexts within which education takes place.

WHICH COUNTRIES PARTICIPATED?

TIMSS was very much a collaborative process among countries. Table 1 shows the countries participating in the TIMSS testing at the primary grades. Each participant designated a national center to conduct the activities of the study and a National Research Coordinator (NRC) to assume responsibility for the successful completion of these tasks.[4] For the sake of comparability, all testing was conducted towards the end of the school year. The four countries on a Southern Hemisphere school schedule (Australia, Korea, New Zealand, and Singapore) tested in September through November of 1994, which was the end of their school year. The remaining countries tested the mathematics and science achievement of their students towards the end of

---

[3] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College. Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

[4] Appendix D lists the National Research Coordinators as well as the members of the TIMSS advisory committees.

Table 1

TIMSS Countries Testing in the Primary Grades[1]

- Australia
- Austria
- Canada
- Cyprus
- Czech Republic
- England
- Greece
- Hong Kong
- Hungary
- Iceland
- Indonesia
- Iran, Islamic Republic
- Ireland
- Israel
- Italy
- Japan
- Korea
- Kuwait
- Latvia
- Mexico
- Netherlands
- New Zealand
- Norway
- Portugal
- Scotland
- Singapore
- Slovenia
- Thailand
- United States

---

[1] Indonesia and Italy were unable to complete the steps necessary for their data to appear in this report.
Please see Appendix A, Figure A.1, for countries participating in other components of the TIMSS achievement testing.
Mexico participated in the testing portion of TIMSS, but chose not to release its results at grades 3 and 4 in the international report.

the 1994-95 school year, most often in May and June of 1995. Because Italy and Indonesia were unable to complete the steps necessary for their inclusion in this report, the tables throughout the report do not include data for these two countries. Results are also not presented for Mexico which chose not to release its third- and fourth-grade results in the international reports.

Table 2 shows information about the lower and upper grades tested in each country, including the country names for those two grades and the years of formal schooling students in those grades had completed when they were tested for TIMSS. Table 2 reveals that for most, but not all, countries, the two grades tested represented the third and fourth years of formal schooling. Thus, solely for convenience, the report often refers to the upper grade tested as the fourth grade and the lower grade tested as the third grade. Two countries, Israel and Kuwait, tested only at the upper grade.

Having valid and efficient samples in each country is crucial to the quality and success of any international comparative study. The accuracy of the survey results depends on the quality of sampling information available, and particularly on the quality of the samples. TIMSS developed procedures and guidelines to ensure that the national samples were of the highest quality possible. Standards for coverage of the target population, participation rates, and the age of students were established, as were clearly documented procedures on how to obtain the national samples. For the most part, the national samples were drawn in accordance with the TIMSS standards, and achievement results can be compared with confidence. However, despite efforts to meet the TIMSS specifications, some countries did not do so. These countries are specially annotated and/or shown in separate sections of the tables in this report.[5]

BEST COPY AVAILABLE

---

[5] The TIMSS sampling requirements and the outcomes of the sampling procedures are described in Appendix A.

Table 2

Information About the Grades Tested

Country	Lower Grade: Country's Name for Lower Grade	Lower Grade: Years of Formal Schooling Including Lower Grade[1]	Upper Grade: Country's Name for Upper Grade	Upper Grade: Years of Formal Schooling Including Upper Grade[1]
[2] Australia	3 or 4	3 or 4	4 or 5	4 or 5
Austria	3	3	4	4
Canada	3	3	4	4
Cyprus	3	3	4	4
Czech Republic	3	3	4	4
England	Year 4	4	Year 5	5
Greece	3	3	4	4
Hong Kong	Primary 3	3	Primary 4	4
Hungary	3	3	4	4
Iceland	3	3	4	4
Iran, Islamic Rep.	3	3	4	4
Ireland	3rd Class	3	4th Class	4
Israel	–	–	4	4
[3] Japan	3rd Grade	3	4th Grade	4
Korea	3rd Grade	3	4th Grade	4
Kuwait	–	–	5	5
Latvia	3	3	4	4
[4] Netherlands	5	3	6	4
[5] New Zealand	Standard 2	3.5–4.5	Standard 3	4.5–5.5
Norway	2	2	3	3
Portugal	3	3	4	4
Scotland	Year 4	4	Year 5	5
Singapore	Primary 3	3	Primary 4	4
Slovenia	3	3	4	4
Thailand	Primary 3	3	Primary 4	4
United States	3	3	4	4

[1] Years of schooling based on the number of years children in the grade level have been in formal schooling, beginning with primary education (International Standard Classification of Education Level 1). Does not include preprimary education.

[2] Australia: Each state/territory has its own policy regarding age of entry to primary school. In 4 of the 8 states/territories students were sampled from grades 3 and 4; in the other four states/territories students were sampled from grades 4 and 5.

[3] Japan: 3rd Grade Elementary and 4th Grade Elementary

[4] In the Netherlands kindergarten is integrated with primary education. Grade-counting starts at age 4 (formerly kindergarten 1). Formal schooling in reading, writing, and arithmetic starts in grade 3, age 6.

[5] New Zealand: The majority of students begin primary school on or near their 5th birthday so the "years of formal schooling" vary.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

What Was the Nature of the Mathematics Test?

Together with the quality of the samples, the quality of the test also receives considerable scrutiny in any comparative study. All participants wish to ensure that the achievement items are appropriate for their students and reflect their current curriculum. Developing the TIMSS tests was a cooperative venture involving all of the NRCs during the entire process. Through a series of efforts, countries submitted items that were reviewed by mathematics subject-matter specialists, and additional items were written to ensure that the desired mathematics topics were covered adequately. Items were piloted, the results reviewed, and new items were written and piloted. The resulting TIMSS mathematics test contained 102 items representing a range of mathematics topics and skills.

The TIMSS curriculum frameworks described the content dimensions for the TIMSS tests as well as performance expectations (behaviors that might be expected of students in school mathematics).[6] Six content areas are covered in the mathematics test taken by third- and fourth-grade students. These areas and the percentage of the test items devoted to each are: whole numbers (25%), fractions and proportionality (21%); measurement, estimation, and number sense (20%); data representation, analysis, and probability (12%); geometry (14%); and patterns, relations, and functions (10%). The performance expectations include: knowing (41%); performing routine procedures (16%); using complex procedures (24%); and solving problems (20%).

About one-fourth of the questions were in the free-response format, requiring students to generate and write their answers. These questions, some of which required extended responses, were allotted approximately one-third of the testing time. Responses to the free-response questions were evaluated to capture diagnostic information, and some were scored using procedures that permitted partial credit.[7] Chapter 3 of this report contains 30 example items illustrating the range of mathematics concepts and processes addressed by the TIMSS test.

The TIMSS tests were prepared in English and translated into the necessary additional languages using explicit guidelines and procedures. A series of verification checks were conducted to ensure the comparability of the translations.[8]

---

[6] Robitaille, D.F., McKnight, C.C., Schmidt, W.H., Britton, E.D., Raizen, S.A., and Nicol, C. (1993). *TIMSS Monograph No. 1: Curriculum Frameworks for Mathematics and Science.* Vancouver, B.C.: Pacific Educational Press.

[7] TIMSS scoring reliability studies within and across countries indicate that the percent of exact agreement for correctness scores averaged well above 90%. For more details, see Appendix A.

[8] See Appendix A for more information about the translation procedures.

The tests were given so that no one student took all of the items, which would have required about four hours for both mathematics and science. Instead, the tests were assembled in eight booklets, each containing approximately one hour of material. Each student took only one booklet,[9] and the items were rotated through the booklets so that each one was answered by a representative sample of students.

TIMSS conducted a Test-Curriculum Matching Analysis whereby countries examined the TIMSS test to identify items measuring topics not addressed in their curricula. The analysis showed that omitting such items for each country had little effect on the overall pattern of achievement results across all countries.[10]

HOW DO COUNTRY CHARACTERISTICS DIFFER?

International studies of student achievement provide valuable comparative information about student performance and instructional practices. Along with the benefits of international studies, though, are challenges associated with comparing achievement across countries, cultures, and languages. In TIMSS, extensive efforts were made to attend to these issues through careful planning and documentation, cooperation among the participating countries, standardized procedures, and rigorous attention to quality control throughout.[11]

Beyond the integrity of the study procedures, the results of comparative studies such as TIMSS also need to be considered in light of the larger contexts in which students are educated and the kinds of system-wide factors that might influence students' opportunity to learn. A number of these factors are more fully described in *National Contexts for Mathematics and Science Education: An Encyclopedia of the Education Systems Participating in TIMSS*;[12] however, some selected demographic characteristics of the TIMSS countries are presented in Table 3. Table 4 contains information about public expenditure on education. The information in these two tables shows that some of the TIMSS countries are densely populated and others are more rural, some are large and some small, and some expend considerably more resources on education than others. Although these factors do not necessarily determine high or low performance in mathematics, they do provide a context for considering the difficulty of the educational task from country to country.

Describing students' educational opportunities also includes understanding the knowledge and skills that students are supposed to master. To help complete the picture of educational practices in the TIMSS countries, mathematics and curriculum specialists within each country provided detailed categorizations of their curriculum guides,

---

[9] Primary students were given a break during the testing sessions. Four clusters of items (37 minutes total) were administered prior to the break and three clusters (27 minutes total) after the break.

[10] Results of the Test-Curriculum Matching Analysis are presented in Appendix B.

[11] Appendix A contains an overview of the procedures used and cites a number of references providing details about TIMSS methodology.

[12] Robitaille, D.F. (Ed.). (1997). *National Contexts for Mathematics and Science Education: An Encyclopedia of the Education Systems Participating in TIMSS.* Vancouver, B.C.: Pacific Educational Press.

Table 3

Selected Demographic Characteristics of TIMSS Countries

Country	Population Size (1.000)	Area of Country (1000 Square Kilometers)	Density (Population per Square Kilometer)	Percentage of Population Living in Urban Areas	Life Expectancy	Percent in Secondary School
Australia	17843	7713	2.29	84.8	77	84
Austria	8028	84	95.28	55.5	77	107
Canada	29248	9976	2.90	76.7	78	88
Cyprus	726	9	77.62	53.6	77	95
Czech Republic	10333	79	130.99	65.3	73	86
[6] England	48533	130	373.33	–	77	–
Greece	10426	132	78.63	64.7	78	99
[7] Hong Kong	6061	1	5691.35	94.8	78	98
Hungary	10261	93	110.03	64.2	70	81
Iceland	266	103	2.56	91.4	79	103
Iran	62550	1648	36.98	58.5	68	66
Ireland	3571	70	50.70	57.4	76	105
Israel	5383	21	252.14	90.5	77	87
Japan	124961	378	329.63	77.5	79	96
Korea	44453	99	444.92	79.8	71	93
Kuwait	1620	18	80.42	96.8	76	60
Latvia	2547	65	40.09	72.6	68	87
Netherlands	15381	37	409.30	88.9	78	93
New Zealand	3493	271	12.78	85.8	76	104
Norway	4337	324	13.31	73.0	78	116
Portugal	9902	92	106.95	35.2	75	81
[8] Scotland	5132	79	65.15	–	75	–
Singapore	2930	1	4635.48	100.0	75	84
Slovenia	1989	20	97.14	62.7	74	85
Thailand	58024	513	111.76	31.9	69	37
United States	260650	9809	27.56	76.0	77	97

[1] Estimates for 1994 based, in most cases, on a de facto definition. Refugees not permanently settled in the country of asylum are generally considered to be part of their country of origin.

[2] Area is the total surface area in square kilometers, comprising all land area and inland waters.

[3] Density is population per square kilometer of total surface area.

[4] Number of years a newborn infant would live if prevailing patterns of mortality at its birth were to stay the same throughout its life.

[5] Gross enrollment of all ages at the secondary level as a percentage of school-age children as defined by each country. This may be reported in excess of 100% if some pupils are younger or older than the country's standard range of secondary school age.

[6] Annual Abstract of Statistics, Office of National Statistics.

[7] Number for Secondary Enrollment is from Education Department (1995) Education Indicators for the Hong Kong Education System (unpublished document).

[8] Registrar General for Scotland Annual Report 1995 and Scottish Abstract of Statistics 1993.

(–) A dash indicates the data were unavailable.

SOURCE: The World Bank, Social Indicators of Development, 1996.

Table 4

Public Expenditure on Education at Primary and Secondary Levels[1] in TIMSS Countries

Country	Gross National Product per Capita (US Dollars)[2]	Gross National Product per Capita (Intl. Dollars)[3]	Public Expenditure on Education (Levels 1 & 2) as % of Gross National Product[4]	Public Expenditure on Education (Intl. Dollars per Capita)[5]
Australia	17980	19000	3.69	701
Austria	24950	20230	4.24	858
Canada	19570	21230	4.62	981
Cyprus[6]	10380	–	3.60	–
Czech Republic	3210	7910	3.75	297
England[7]	18410	18170	3.57	649
Greece	7710	11400	2.27	259
Hong Kong[8]	21650	23080	1.34	309
Hungary	3840	6310	4.31	272
Iceland	24590	18900	4.77	902
Iran	–	4650	3.93	183
Ireland	13630	14550	4.21	613
Israel	14410	15690	3.72	584
Japan	34360	21350	2.82	602
Korea	8220	10540	3.43	362
Kuwait	19040	24500	3.46	848
Latvia	2290	5170	2.85	147
Netherlands	21970	18080	3.30	597
New Zealand	13190	16780	3.15	529
Norway	26480	21120	5.26	1111
Portugal	9370	12400	2.98	370
Scotland[7]	18410	18170	3.57	649
Singapore	23360	21430	3.38	724
Slovenia	7140	–	4.20	–
Thailand	2210	6870	3.00	206
United States	25860	25860	4.02	1040

[1] The levels of education are based on the International Standard Classification of Education. The duration of Primary (level 1) and Secondary (level 2) vary depending on the country.

[2] (SOURCE: The World Bank Atlas, 1996). Estimates for 1994 at current market prices in U.S. dollars, calculated by the conversion method used for the World Bank Atlas.

[3] (SOURCE: The World Bank Atlas, 1996). Converted at purchasing power parity (PPP). PPP is defined as number of units of a country's currency required to buy same amounts of goods and services in domestic market as one dollar would buy in the United States.

[4] (SOURCE: UNESCO Statistical Yearbook, 1995). Calculated by multiplying the Public Expenditure on Education as a % of GNP by the percentage of public education expenditure on the first and second levels of education. Figures represent the most recent figures released.

[5] Calculated by multiplying the GNP per Capita (Intl. Dollars) column by Public Expenditure on Education.

[6] GNP per capita figure for Cyprus is for 1993.

[7] The figures for England and Scotland are for the United Kingdom.

[8] Calculated using Education Department (1995) Education Indicators for the Hong Kong Education System (unpublished document).

(–) A dash indicates the data was unavailable.

textbooks, and curricular materials. The initial results from this effort can be found in two reports, entitled *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics* and *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*.[13]

Depending on the educational system, students' learning goals are commonly set at one of three main levels: the national or regional level, the school level, or the classroom level. Some countries are highly centralized, with the ministry of education (or highest authority in the system) having exclusive responsibility for making the major decisions governing the direction of education. In others, such decisions are made regionally or locally. Each approach has its strengths and weaknesses. Centralized decision making can add coherence in curriculum coverage, but may constrain a school's or teacher's flexibility in tailoring instruction to the different needs of students.

Figures 1, 2, and 3 show the degree of centralization in the TIMSS countries regarding decision-making about curriculum syllabi, textbooks, and examinations. Of the TIMSS participants at the primary school level, 18 reported nationally centralized decision-making about curriculum. Fewer countries reported nationally centralized decision-making about textbooks, although 11 participants were in this category. Six countries reported nationally centralized decision-making about examinations. Regional decision-making about these three aspects of education does not appear to be very common among the TIMSS countries, with only one or two countries reporting this level of decision-making for curriculum syllabi and textbooks, and none reporting it for examinations.

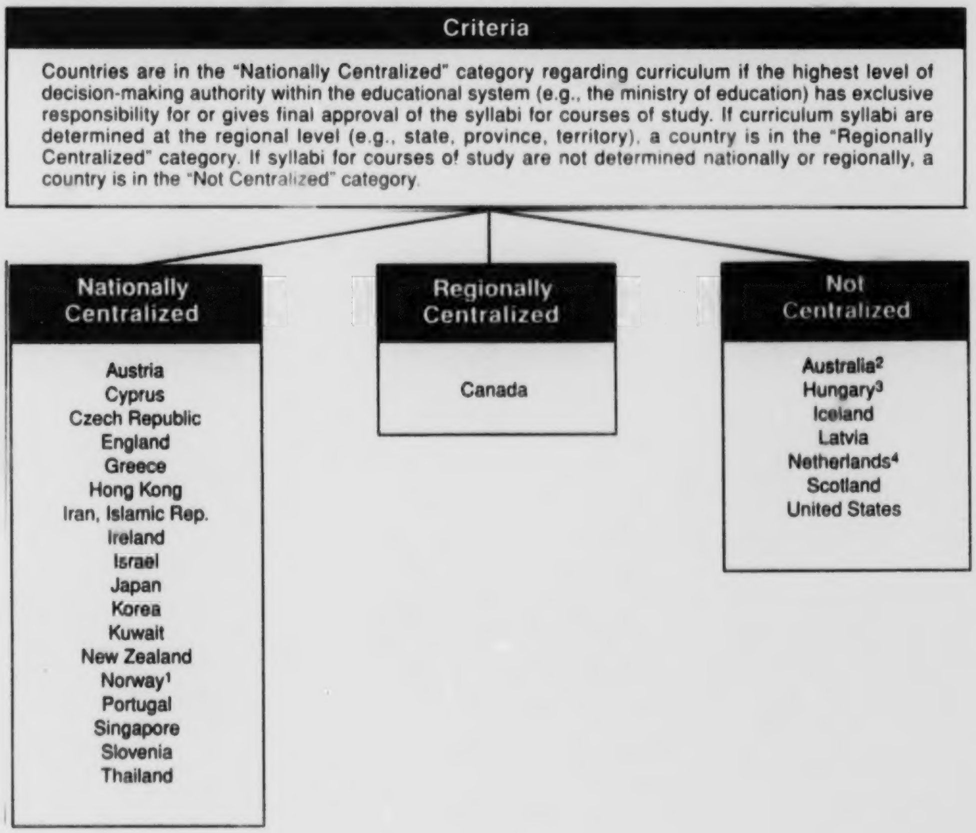
Most countries reported having centralized decision-making for one or two of the areas and "not centralized" decision-making for one or two of the areas. Only two countries – Hong Kong and Singapore – reported nationally centralized decision-making for all three areas: curriculum syllabi, textbooks, and examinations. Six countries – Australia, Hungary, Iceland, Latvia, Scotland, and the United States – reported that decision-making is not centralized for any of these areas.

---

[13] Schmidt, W.H., McKnight, C.C., Valverde, G. A., Houang, R.T., and Wiley, D. E. (1997). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*. Dordrecht, the Netherlands: Kluwer Academic Publishers. Schmidt, W.H., Raizen, S.A., Britton, E.D., Bianchi, L.J., and Wolfe, R.G. (in press). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*. Dordrecht, the Netherlands: Kluwer Academic Publishers.

Figure 1

Centralization of Decision-Making Regarding Curriculum Syllabi



Criteria

Countries are in the "Nationally Centralized" category regarding curriculum if the highest level of decision-making authority within the educational system (e.g., the ministry of education) has exclusive responsibility for or gives final approval of the syllabi for courses of study. If curriculum syllabi are determined at the regional level (e.g., state, province, territory), a country is in the "Regionally Centralized" category. If syllabi for courses of study are not determined nationally or regionally, a country is in the "Not Centralized" category.

Nationally Centralized	Regionally Centralized	Not Centralized
Austria	Canada	Australia[2]
Cyprus		Hungary[3]
Czech Republic		Iceland
England		Latvia
Greece		Netherlands[4]
Hong Kong		Scotland
Iran, Islamic Rep.		United States
Ireland		
Israel		
Japan		
Korea		
Kuwait		
New Zealand		
Norway[1]		
Portugal		
Singapore		
Slovenia		
Thailand		

[1] Norway: The National Agency of Education provides goals which schools are required to work towards. Schools have the freedom to implement the goals based on local concerns.

[2] Australia: Students tested in TIMSS were educated under a decentralized system. Reforms beginning in 1994 are introducing regionally centralized (state-determined) curriculum guidelines.

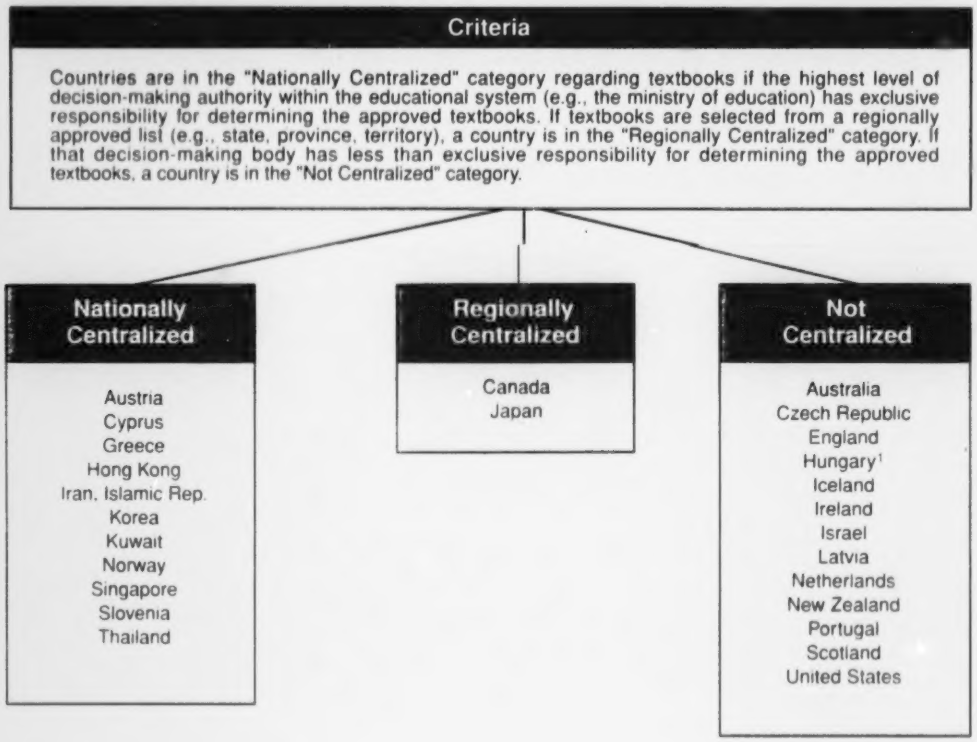
[3] Hungary: Hungary is in the midst of changing from a highly centralized system to one in which local authorities and schools have more autonomy.

[4] Netherlands: The Ministry of Education sets core objectives (for subjects in primary education and in 'basic education' at lower secondary level) and goals/objectives (for subjects in the four student ability tracks in secondary education) which schools are required to work towards. Schools have the freedom, though, to decide how to reach these objectives.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Figure 2

Centralization of Decision-Making Regarding Textbooks



Criteria

Countries are in the "Nationally Centralized" category regarding textbooks if the highest level of decision-making authority within the educational system (e.g., the ministry of education) has exclusive responsibility for determining the approved textbooks. If textbooks are selected from a regionally approved list (e.g., state, province, territory), a country is in the "Regionally Centralized" category. If that decision-making body has less than exclusive responsibility for determining the approved textbooks, a country is in the "Not Centralized" category.

Nationally Centralized	Regionally Centralized	Not Centralized
Austria Cyprus Greece Hong Kong Iran, Islamic Rep. Korea Kuwait Norway Singapore Slovenia Thailand	Canada Japan	Australia Czech Republic England Hungary[1] Iceland Ireland Israel Latvia Netherlands New Zealand Portugal Scotland United States

[1] Hungary: Hungary is in the midst of changing from a highly centralized system to one in which local authorities and schools have more autonomy.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Figure 3

Centralization of Decision-Making Regarding Examinations

Criteria

Countries are in the "Nationally Centralized" category regarding examinations if the highest level of decision-making authority within the educational system (e.g., the ministry of education) has exclusive responsibility for or gives final approval of the content of examinations. The notes explain during which school years the examinations are administered. If that decision-making body has less than exclusive responsibility for or final approval of the examination content, the country is in the "Not Centralized" category.

Nationally Centralized

England[1]
Hong Kong[2]
Ireland[3]
New Zealand[4]
Singapore

Not Centralized

Australia[5]
Austria
Canada
Cyprus
Czech Republic
Greece
Hungary
Iceland
Iran, Islamic Rep.
Israel
Japan
Korea
Kuwait
Latvia[6]
Netherlands[7]
Norway
Portugal
Scotland
Slovenia
Thailand
United States

---

[1] England: Centralized national curriculum assessments taken at Years 2, 6 and 9. Regionally centralized examinations are taken at Years 11 and 13.

[2] Hong Kong: Centralized examination taken at Year 11.

[3] Ireland: Centralized examinations taken at Grades 9 and 12.

[4] New Zealand: Centralized examinations are taken at Years 11, 12 and 13. Centralized national monitoring at Years 4 and 8.

[5] Australia: Not centralized as a country, but low-stakes statewide population assessments are undertaken in most states at one or more of Grades 3, 5, 6,7 and 10. In most states centralized examinations are taken at Grade 12.

[6] Latvia: Centralized examinations taken at Grades 9 and 12.

[7] Netherlands: The majority of schools (71% in 1996) participate in a non-compulsory standardized test which is administered at the end of primary education (Cito eindtoets).School-leaving examinations consisting of a centralized part and a school-bound part are taken in the final grades of the four student ability tracks in secondary education.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Chapter 1

INTERNATIONAL STUDENT ACHIEVEMENT IN MATHEMATICS

WHAT ARE THE OVERALL DIFFERENCES IN MATHEMATICS ACHIEVEMENT?

Chapter 1 summarizes achievement on the TIMSS mathematics test for each of the participating countries. Comparisons are provided overall and by gender for the upper grade tested (often the fourth grade) and the lower grade tested (often the third grade), as well as for 9-year-olds.

Table 1.1 presents the mean (or average) achievement for 26 countries at the fourth grade.[1] The 17 countries shown in decreasing order of mean achievement in the upper part of the table were judged to have met the TIMSS requirements for testing a representative sample of students. Although all countries tried very hard to meet the TIMSS sampling requirements, several encountered resistance from schools and teachers and did not have participation rates of 85% or higher as specified in the TIMSS guidelines (i.e., Australia, Austria, Latvia, and the Netherlands). To provide a better curricular match, Slovenia elected to test its third- and fourth-grade students, even though that meant not testing the two grades with the most 9-year-olds and led to its students being somewhat older than those in the other countries. The countries in the remaining two categories encountered various degrees of difficulty in implementing the prescribed methods for sampling classrooms within schools. A full discussion of the sampling procedures and outcomes for each country can be found in Appendix A.

To aid in interpretation, the table also contains the years of formal schooling and average age of the students. Equivalence of chronological age does not necessarily mean that students have received the same number of years of formal schooling or studied the same curriculum. Notably, students in Norway had fewer years of formal schooling than their counterparts in other countries, and those in Scotland, England, New Zealand, and Kuwait had more. Countries with a high percentage of older students may have policies that include retaining students in lower grades.

The results reveal substantial differences in average mathematics achievement between the top- and bottom-performing countries, although most countries had achievement somewhere in the middle ranges. To illustrate the broad range of achievement both across and within countries, Table 1.1 also provides a visual representation of the distribution of student performance within each country.

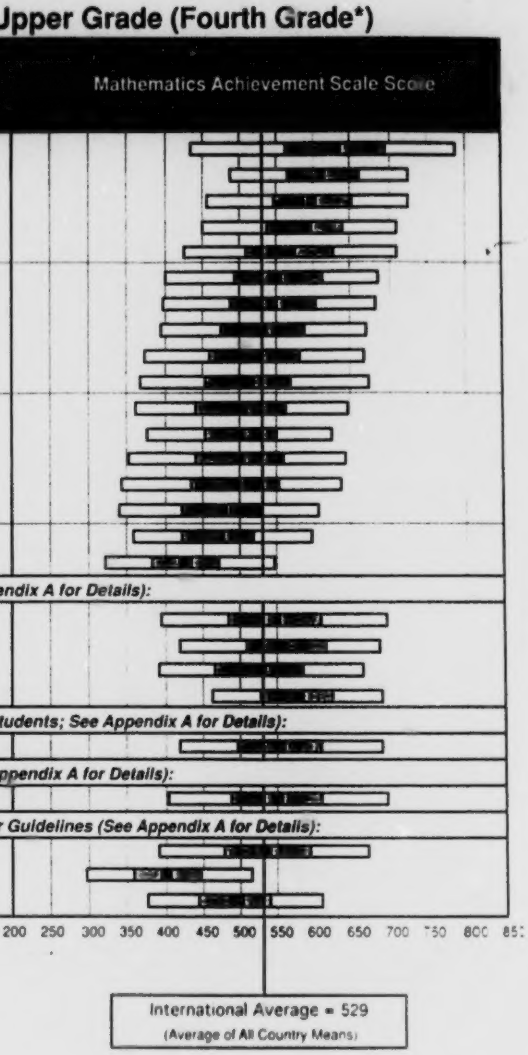
---

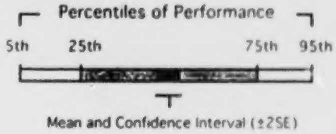
[1] TIMSS used item response theory (IRT) methods to summarize the achievement results for both grades on a scale with a mean of 500 and a standard deviation of 100. Scaling averages students' responses to the subsets of items they took in a way that accounts for differences in the difficulty of those items. It allows students' performance to be summarized on a common metric even though individual students responded to different items in the mathematics test. For more detailed information, see the "IRT Scaling and Data Analysis" section of Appendix A.

Table 1.1

Distributions of Mathematics Achievement - Upper Grade (Fourth Grade*)

Country	Mean	Years of Formal Schooling	Average Age
Singapore	625 (5.3)	4	10.3
Korea	611 (2.1)	4	10.3
Japan	597 (2.1)	4	10.4
Hong Kong	587 (4.3)	4	10.1
Czech Republic	567 (3.3)	4	10.4
Ireland	550 (3.4)	4	10.3
United States	545 (3.0)	4	10.2
Canada	532 (3.3)	4	10.0
[†] Scotland	520 (3.9)	5	9.7
[†2] England	513 (3.2)	5	10.0
Cyprus	502 (3.1)	4	9.8
Norway	502 (3.0)	3	9.9
New Zealand	499 (4.3)	4.5–5.5	10.0
Greece	492 (4.4)	4	9.6
Portugal	475 (3.5)	4	10.4
Iceland	474 (2.7)	4	9.6
Iran, Islamic Rep.	429 (4.0)	4	10.5
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	546 (3.1)	4 or 5	10.2
Austria	559 (3.1)	4	10.5
[1] Latvia (LSS)	525 (4.8)	4	10.5
Netherlands	577 (3.4)	4	10.3
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	552 (3.2)	4	10.9
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	548 (3.7)	4	10.4
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
[1] Israel	531 (3.5)	4	10.0
Kuwait	400 (2.8)	5	10.8
Thailand	490 (4.7)	4	10.5




Percentiles of Performance
5th
25th
75th
95th
Mean and Confidence Interval (±2SE)

---

*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

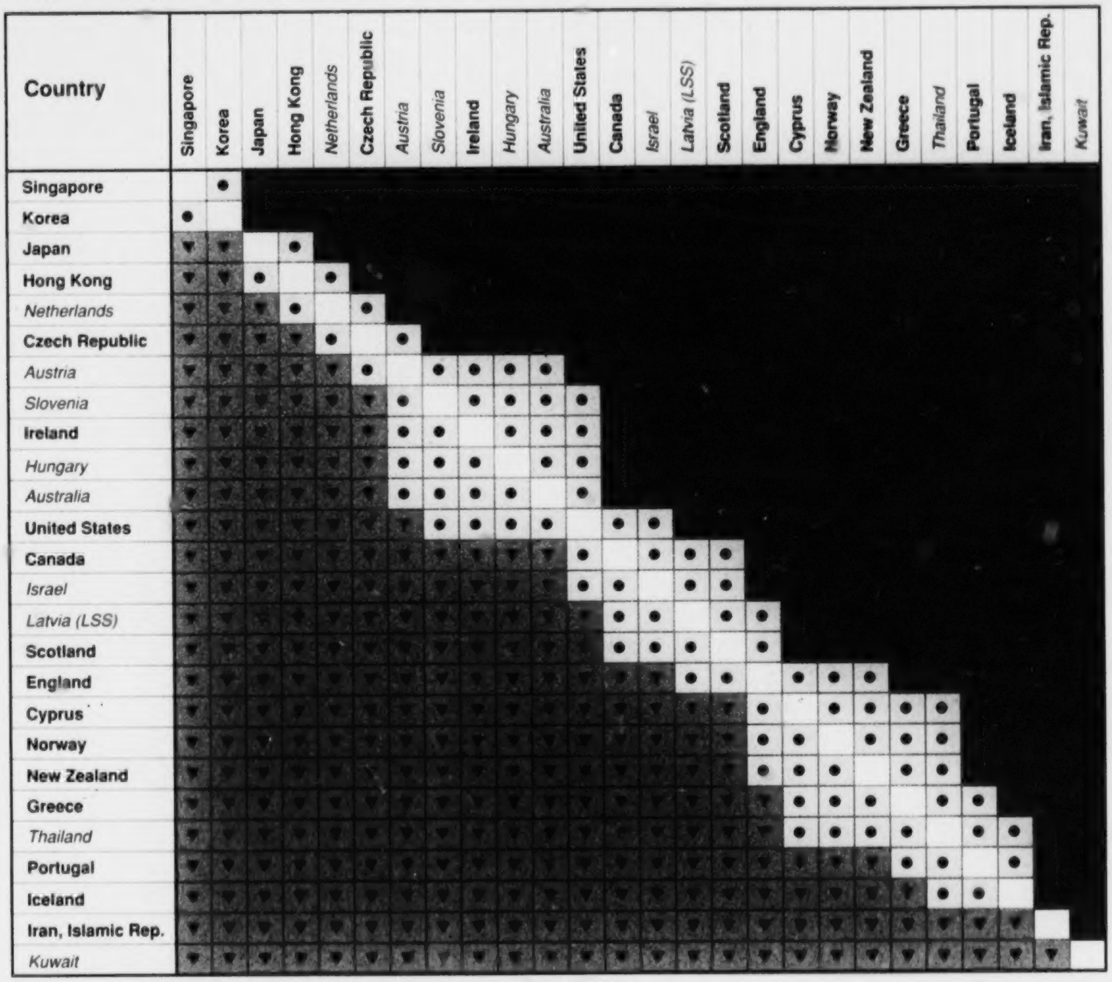
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 1.1

Multiple Comparisons of Mathematics Achievement - Upper Grade (Fourth Grade*)

Instructions: Read **across** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the two countries.[†]



Country	**Singapore**	**Korea**	**Japan**	**Hong Kong**	*Netherlands*	**Czech Republic**	*Austria*	*Slovenia*	**Ireland**	*Hungary*	*Australia*	**United States**	**Canada**	*Israel*	*Latvia (LSS)*	**Scotland**	**England**	**Cyprus**	**Norway**	**New Zealand**	**Greece**	*Thailand*	**Portugal**	**Iceland**	**Iran, Islamic Rep.**	*Kuwait*
Singapore		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Korea	●		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Japan	▼	▼		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hong Kong	▼	▼	●		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Netherlands	▼	▼	▼	●		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Czech Republic	▼	▼	▼	▼	●		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Austria	▼	▼	▼	▼	▼	●		●	●	●	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Slovenia	▼	▼	▼	▼	▼	▼	●		●	●	●	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Ireland	▼	▼	▼	▼	▼	▼	●	●		●	●	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hungary	▼	▼	▼	▼	▼	▼	●	●	●		●	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Australia	▼	▼	▼	▼	▼	▼	●	●	●	●		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■
United States	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	■	■	■	■	■	■	■	■	■	■	■	■
Canada	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	●	■	■	■	■	■	■	■	■	■	■
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	■	■	■	■	■	■	■	■	■	■
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	■	■	■	■	■	■	■	■	■
Scotland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	■	■	■	■	■	■	■	■	■
England	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	■	■	■	■	■	■
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	●	●	■	■	■	■
Norway	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	■	■	■	■
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	■	■	■	■
Greece	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	■	■	■
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	■	■
Portugal	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	■	■
Iceland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		■	■
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		■
Kuwait	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

Countries are ordered by mean achievement across the heading and down the rows.

■	Mean achievement significantly higher than comparison country
●	No statistically significant difference from comparison country
▼	Mean achievement significantly lower than comparison country

---

* Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

[†] Statistically significant at .05 level, adjusted for multiple comparisons.

Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Appendix A for details).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Achievement for each country is shown for the 25th and 75th percentiles as well as for the 5th and 95th percentiles.[2] Each percentile point indicates the percentages of students performing below and above that point on the scale. For example, 25% of the fourth-grade students in each country performed below the 25th percentile for that country, and 75% performed above the 25th percentile.

The range between the 25th and 75th percentiles represents performance by the middle half of the students. In contrast, performance at the 5th and 95th percentiles represents the extremes in both lower and higher achievement. The dark boxes at the midpoints of the distributions show the 95% confidence intervals around the average achievement in each country.[3] These intervals can be compared with the international average of 529, which was derived by averaging across the means for each of the 26 participants shown on the table. A number of countries had mean achievement well above the international average of 529, and others had mean achievement well below that level.

Comparisons also can be made across the means and percentiles. For example, average performance in Singapore was comparable to or even exceeded performance at the 95th percentile in several of the lower-performing countries such as Iran and Kuwait. Also, the differences between the extremes in performance were very large within most countries. The range in performance was particularly large in Singapore.

Figure 1.1 provides a method for making appropriate comparisons in overall mean achievement between countries.[4] This figure shows whether or not the differences in mean achievement between pairs of countries are statistically significant. For a given country of interest, read across the figure. A triangle pointing up indicates significantly higher performance than the country listed across the top, a dot indicates no significant difference in performance, and a triangle pointing down indicates significantly lower performance.

At the fourth grade, Singapore and Korea, with all triangles pointing up, had significantly higher mean achievement than the other participating countries. Japan and Hong Kong also performed very well, as did the Netherlands, the Czech Republic, and Austria. Japan performed similarly to Hong Kong and better than all of the other participating countries except Singapore and Korea. Besides showing no significant difference from Japan, Hong Kong also performed about the same as the Netherlands. Interestingly, from the top-performing countries on down through the list of participants, the differences in performance from one country to the next were often negligible. For example, in addition to performing similarly to Hong Kong, the Netherlands performed similarly to the Czech Republic, which also performed similarly to Austria. In turn, Austria also performed similarly to Slovenia, Ireland, Hungary, and Australia.

---

[2] Tables of the percentile values and standard deviations for all countries are presented in Appendix C.

[3] See the "Estimating Sampling Error" section of Appendix A for more details about calculating standard errors and confidence intervals for the TIMSS statistics.

[4] The significance tests in Figures 1.1 and 1.2 are based on a Bonferroni procedure for multiple comparisons that holds to 5% the probability of erroneously declaring the mean of one country to be different from another country.

Despite the small differences from one country to the next, however, spanning across all the participating TIMSS countries, the performance difference from the top-performing to the bottom-performing countries was very large. Because of this large range in performance, the pattern for a number of countries was one of having lower mean achievement than some countries, about the same mean achievement as some countries, and higher mean achievement than other countries. In contrast, Kuwait had significantly lower average performance than the other participating countries, and Iran had lower average performance than all other countries except Kuwait.

Table 1.2 and Figure 1.2 present corresponding data for the third grade.[5] The four highest-performing countries are the same as at the fourth grade, but the pattern is different. Third-grade students in Korea had significantly higher mean achievement than those in all other participating countries except Singapore, where achievement was similar to that in Korea. The third-grade students in Singapore also performed about the same as the students in Japan. Hong Kong also performed very well. Students in Hong Kong performed significantly below those in Singapore, Korea, and Japan, but higher than students in all of the other participating countries. For the remaining countries, performance rankings tended to be similar, but not identical, to those found at the fourth grade. For example, at the third grade, the Czech Republic, the Netherlands, Slovenia, Austria, and Australia all performed at about the same level.

It can be noted that the international average at the fourth grade (529) was approximately 60 points higher than the international average of 470 shown at the third grade. Even though equivalent achievement increases cannot be assumed from grade to grade throughout schooling, this 60-point difference does provide a rough indication of grade-by-grade increases in mathematics achievement during the primary school years. By this gauge, the achievement differences across countries at both grades reflect several grade levels in learning between the higher- and lower-performing countries. A similarly large range in performance can be noted within most countries. Caution is required, however, in using growth from grade to grade as an indicator of achievement. The TIMSS scale measures achievement in mathematics judged to be appropriate for third- and fourth-grade students around the world. Thus, higher performance does not mean that students can do secondary-school mathematics, but only that they are more proficient at primary-school mathematics.

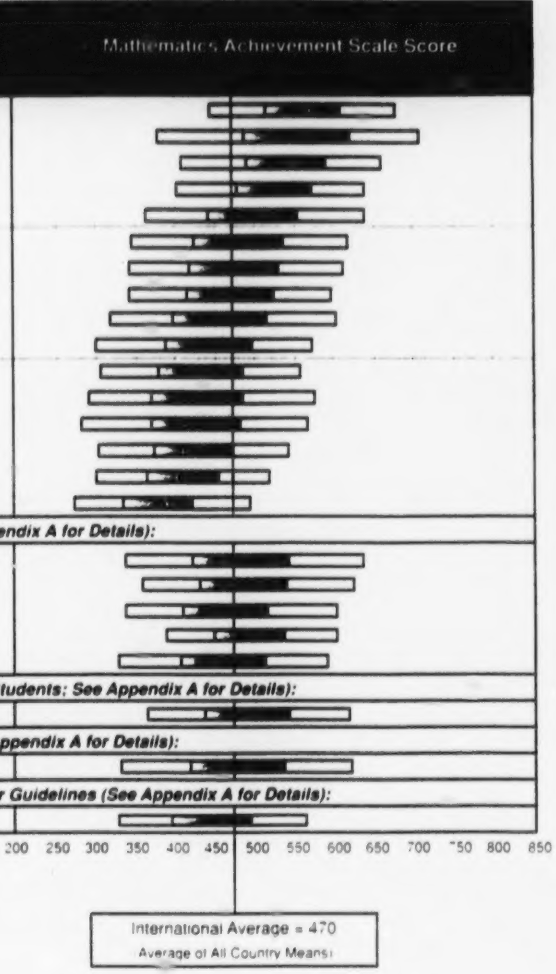
---

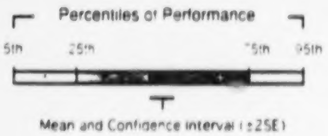
[5] Results are presented for 16 countries in the top portion of Table 1.2 because Scotland did not meet the sampling requirements at this grade. Twenty-four countries are presented in total because Kuwait and Israel tested only the fourth grade.

Table 1.2

Distributions of Mathematics Achievement - Lower Grade (Third Grade*)

Country	Mean	Years of Formal Schooling	Average Age
Korea	**561 (2.3)**	3	9.3
Singapore	**552 (4.8)**	3	9.3
Japan	**538 (1.5)**	3	9.4
Hong Kong	**524 (3.0)**	3	9.1
Czech Republic	**497 (3.3)**	3	9.4
United States	**480 (3.4)**	3	9.2
Ireland	**476 (3.6)**	3	9.3
Canada	**469 (2.7)**	3	9.1
†2 England	**456 (3.0)**	4	9.1
New Zealand	**440 (4.0)**	3.5–4.5	9.0
Cyprus	**430 (2.8)**	3	8.8
Greece	**428 (4.0)**	3	8.6
Portugal	**425 (3.8)**	3	9.1
Norway	**421 (3.1)**	2	8.8
Iceland	**410 (2.8)**	3	8.6
Iran, Islamic Rep.	**378 (3.5)**	3	9.4
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	**483 (4.0)**	3 or 4	9.2
Austria	**487 (5.3)**	3	9.5
1 Latvia (LSS)	**463 (4.3)**	3	9.7
Netherlands	**493 (2.7)**	3	9.3
Scotland	**458 (3.4)**	4	8.7
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	**488 (2.9)**	3	9.9
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	**476 (4.2)**	3	9.4
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
Thailand	**444 (5.1)**	3	9.7




Percentiles of Performance
5th
25th
75th
95th
Mean and Confidence Interval (±2SE)

---

*Third grade in most countries; see Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 1.2

Multiple Comparisons of Mathematics Achievement - Lower Grade (Third Grade*)

Instructions: Read ***across*** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the two countries.[†]

Country	**Korea**	**Singapore**	**Japan**	**Hong Kong**	**Czech Republic**	*Netherlands*	*Slovenia*	*Austria*	*Australia*	**United States**	*Hungary*	**Ireland**	**Canada**	*Latvia (LSS)*	*Scotland*	**England**	*Thailand*	**New Zealand**	**Cyprus**	**Greece**	**Portugal**	**Norway**	**Iceland**	**Iran, Islamic Rep.**
Korea		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Singapore	●		●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Japan	▼	●		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hong Kong	▼	▼	▼		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Czech Republic	▼	▼	▼	▼		●	●	●	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Netherlands	▼	▼	▼	▼	●		●	●	●	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Slovenia	▼	▼	▼	▼	●	●		●	●	●	●	●	■	■	■	■	■	■	■	■	■	■	■	■
Austria	▼	▼	▼	▼	●	●	●		●	●	●	●	●	■	■	■	■	■	■	■	■	■	■	■
Australia	▼	▼	▼	▼	●	●	●	●		●	●	●	●	■	■	■	■	■	■	■	■	■	■	■
United States	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	■	■	■	■	■	■	■	■	■	■
Hungary	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	■	■	■	■	■	■	■	■	■	■
Ireland	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	■	■	■	■	■	■	■	■	■	■
Canada	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	■	■	■	■	■	■	■	■	■
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	■	■	■	■	■	■	■
Scotland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	■	■	■	■	■	■	■
England	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	■	■	■	■	■	■	■
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	■	■	■
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	●	■	■	■
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	■	■
Greece	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	■	■
Portugal	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	■	■
Norway	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	■
Iceland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		■
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

Countries are ordered by mean achievement across the heading and down the rows.

■ Mean achievement significantly higher than comparison country

● No statistically significant difference from comparison country

▼ Mean achievement significantly lower than comparison country

---

*Third grade in most countries; see Table 2 for information about the grades tested in each country.

[†] Statistically significant at .05 level, adjusted for multiple comparisons.

Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Appendix A for details).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE THE INCREASES IN ACHIEVEMENT BETWEEN THE LOWER AND UPPER GRADES?

Table 1.3 shows the increases in mean achievement between the two grades tested in each TIMSS country. Countries in the upper portion of the table are shown in decreasing order by the amount of this difference. Increases in mean performance between the two grades ranged from a high of 84 points in the Netherlands to a low of 46 points in Thailand. This degree of increase can be compared with the difference of 59 points between the international averages of 529 at fourth grade and 470 at third grade. Despite the larger increases in some countries than in others, there is no obvious relationship between mean third-grade performance and the difference between that and mean fourth-grade performance. That is, countries showing the highest performance at the third grade did not necessarily show either the largest or the smallest increases in achievement at the fourth grade. In general, countries with high mean performance in the third grade also had high mean performance in the fourth grade.

Interestingly, the magnitude of the average increase in performance between the third and fourth grades is twice that found between the seventh and eighth grades. Recomputing the international averages found at the seventh and eighth grades[6] for the 26 countries that participated in the testing at the lower grades reveals an average increase of 27 points (from 493 at the seventh grade to 520 at the eighth grade).[7] This finding is consistent with observations made during TIMSS test development[8] that within-country differences in content coverage are generally small for any particular grade at the primary level, but that much new content is covered from one grade to the next. Since for most children the opportunity to learn mathematics is anchored in the school, even one year can make a substantial difference.

---

[6] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

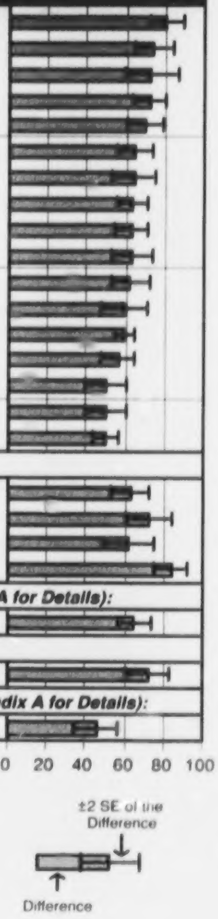
[7] Please see Table A.11 in Appendix A.

[8] Garden, R.A. (1996). "Development of the TIMSS Achievement Items" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No. 2: Research Questions and Study Design.* Vancouver, B.C.: Pacific Educational Press.

Table 1.3

Achievement Differences in Mathematics Between Lower and Upper Grades (Third and Fourth Grades*)

Country	Lower Grade Mean	Upper Grade Mean	Difference
Norway	421 (3.1)	502 (3.0)	81 (4.3)
Ireland	476 (3.6)	550 (3.4)	74 (5.0)
Singapore	552 (4.8)	625 (5.3)	73 (7.2)
Cyprus	430 (2.8)	502 (3.1)	72 (4.2)
Czech Republic	497 (3.3)	567 (3.3)	70 (4.7)
United States	480 (3.4)	545 (3.0)	65 (4.5)
Greece	428 (4.0)	492 (4.4)	64 (5.9)
Iceland	410 (2.8)	474 (2.7)	64 (3.9)
Canada	469 (2.7)	532 (3.3)	63 (4.2)
Hong Kong	524 (3.0)	587 (4.3)	63 (5.3)
† Scotland	458 (3.4)	520 (3.9)	62 (5.1)
New Zealand	440 (4.0)	499 (4.3)	59 (5.9)
Japan	538 (1.5)	597 (2.1)	59 (2.6)
†[2] England	456 (3.0)	513 (3.2)	56 (4.4)
Iran, Islamic Rep.	378 (3.5)	429 (4.0)	51 (5.3)
Portugal	425 (3.8)	475 (3.5)	50 (5.2)
Korea	561 (2.3)	611 (2.1)	50 (3.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	483 (4.0)	546 (3.1)	63 (5.0)
Austria	487 (5.3)	559 (3.1)	72 (6.2)
[1] Latvia (LSS)	463 (4.3)	525 (4.8)	62 (6.4)
Netherlands	493 (2.7)	577 (3.4)	84 (4.3)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	488 (2.9)	552 (3.2)	65 (4.3)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	476 (4.2)	548 (3.7)	72 (5.6)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
Thailand	444 (5.1)	490 (4.7)	46 (6.9)



---

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

What Are the Differences in Performance Compared to Three Marker Levels of International Mathematics Achievement?

Tables 1.4 and 1.5 portray performance in terms of international levels of achievement for the fourth and third grades, respectively. Since the TIMSS achievement tests do not have pre-specified performance standards, three marker levels were chosen on the basis of the combined performance of all students at a grade level in the study – the Top 10%, the Top Quarter (25%), and the Top Half (50%). For example, Table 1.4 shows that 10% of all fourth graders in countries participating in the TIMSS study achieved at the level of 658 or higher. This score point, then, was designated as the marker level for the Top 10%. Similarly, the Top Quarter marker level was determined as 601 and the Top Half marker level as 535. At the third grade, these marker levels are 592, 538, and 474 respectively.

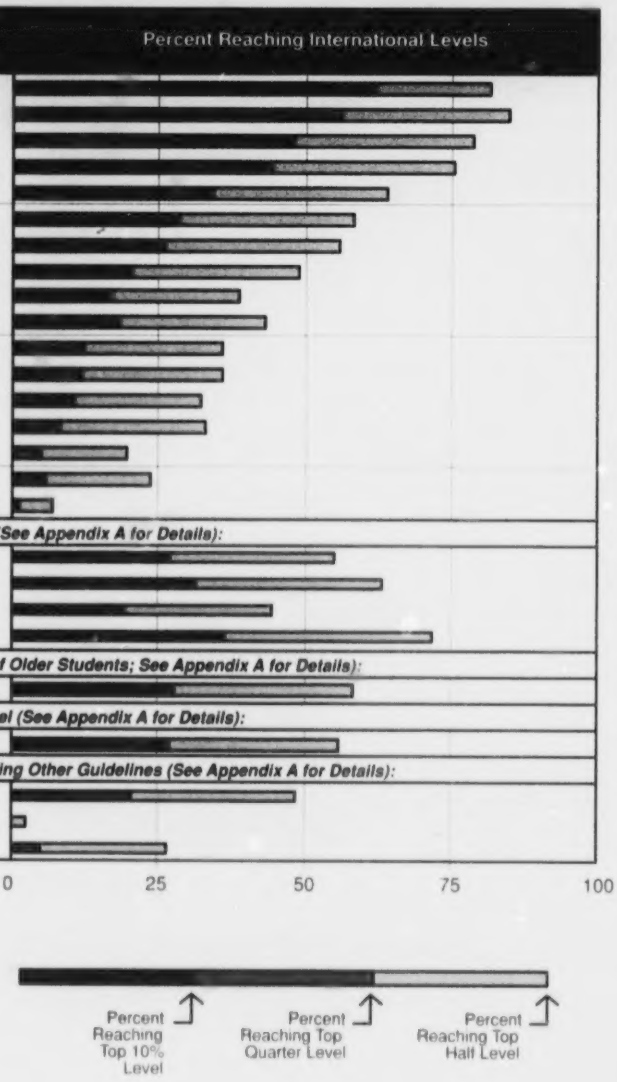
If every country had the same distribution of high-, medium-, and low-performing students, then each country would be expected to have approximately 10% of its students reaching the Top 10% level, 25% reaching the Top Quarter level, and 50% reaching the Top Half level. Although no country achieved exactly this pattern at either grade tested, the data in Tables 1.4 and 1.5 indicate that the United States at the fourth grade as well as the United States, Slovenia, and especially Hungary at the third grade came close to the international norm from the perspective of relative percentages of high-performing students. In contrast, at both grades nearly 40% of the students in Singapore (39% at the fourth grade and 36% at the third grade) reached the Top 10% level, about 60% reached the Top Quarter level (62% and 57%), and about 80% performed at or above the Top Half level (82% and 79%).

It can be informative to look at performance at each marker level. For example, the results in Table 1.4 show that 10% of the students in Ireland attained the Top 10% level, and that achievement exceeded the Top Quarter and Top Half levels (28% and 59% respectively). In Canada and Israel performance approximated the marker level for Top Half (49%), but fell slightly short of the Top 10% and Top Quarter levels.

Table 1.4

Percentages of Students Achieving International Marker Levels in Mathematics Upper Grade (Fourth Grade*)

Country	Top 10% Level	Top Quarter Level	Top Half Level
Singapore	**39 (2.3)**	**62 (2.0)**	**82 (1.2)**
Korea	26 (1.2)	56 (1.3)	85 (0.8)
Japan	23 (0.9)	48 (1.2)	79 (0.8)
Hong Kong	18 (1.5)	44 (2.5)	76 (1.8)
Czech Republic	15 (1.3)	34 (1.6)	64 (1.4)
Ireland	10 (0.7)	28 (1.6)	59 (1.8)
United States	9 (0.8)	26 (1.3)	56 (1.6)
Canada	7 (0.8)	21 (1.4)	49 (1.5)
†[2] England	7 (0.7)	17 (1.2)	39 (1.5)
† Scotland	6 (0.8)	18 (1.4)	43 (1.8)
Cyprus	4 (0.5)	12 (0.9)	36 (1.5)
New Zealand	3 (0.7)	12 (1.1)	36 (2.0)
Greece	3 (0.5)	11 (0.9)	32 (1.8)
Norway	2 (0.3)	8 (0.8)	33 (1.6)
Iceland	1 (0.3)	5 (0.7)	20 (1.3)
Portugal	1 (0.2)	6 (0.6)	24 (1.3)
Iran, Islamic Rep.	0 (0.1)	1 (0.4)	7 (1.3)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	12 (0.7)	27 (1.2)	55 (1.4)
Austria	11 (1.1)	31 (1.5)	63 (1.6)
[1] Latvia (LSS)	6 (1.3)	19 (2.1)	44 (2.3)
Netherlands	13 (1.1)	36 (1.9)	72 (1.8)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	11 (0.9)	28 (1.4)	58 (1.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	11 (1.1)	27 (1.7)	56 (1.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
[1] Israel	6 (0.7)	21 (1.5)	49 (1.9)
Kuwait	0 (0.1)	0 (0.1)	3 (0.4)
Thailand	1 (0.2)	5 (1.0)	27 (2.4)



The international levels correspond to the percentiles computed from the combined data from all of the participating countries.

Top 10% Level (90th Percentile) = 658
Top Quarter Level (75th Percentile) = 601
Top Half Level (50th Percentile) = 535

---

*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

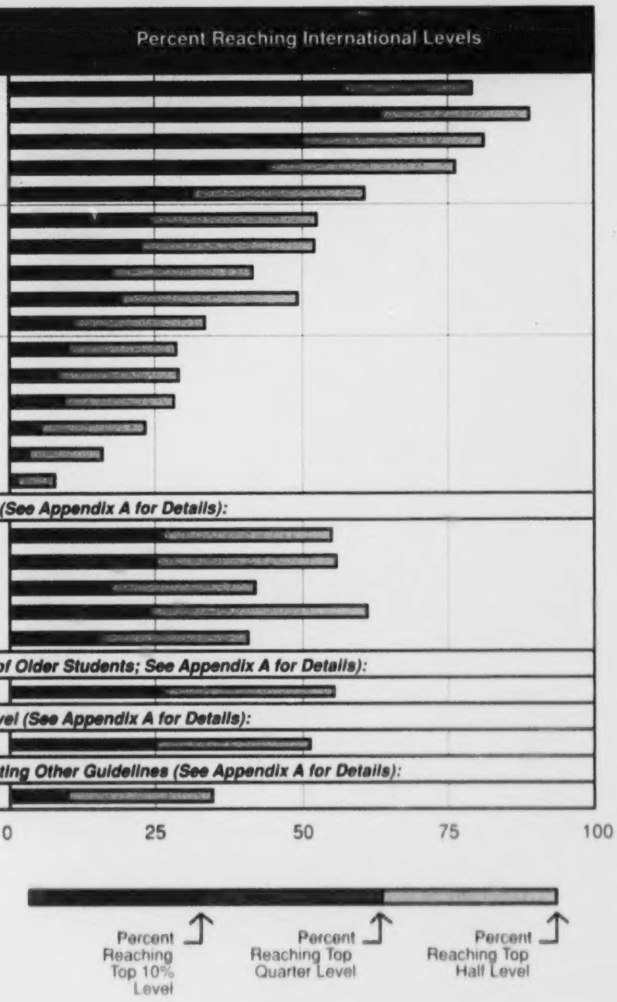
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 1.5

Percentages of Students Achieving International Marker Levels in Mathematics Lower Grade (Third Grade*)

Country	Top 10% Level	Top Quarter Level	Top Half Level
Singapore	36 (2.1)	57 (1.9)	79 (1.3)
Korea	32 (1.3)	64 (1.4)	89 (0.7)
Japan	24 (0.8)	50 (0.9)	81 (0.7)
Hong Kong	17 (1.4)	45 (1.9)	76 (1.4)
Czech Republic	12 (1.1)	31 (1.7)	61 (1.6)
United States	8 (1.0)	24 (1.7)	53 (1.9)
Ireland	7 (0.8)	22 (1.5)	52 (2.0)
[1,2] England	6 (0.5)	18 (1.1)	42 (1.4)
Canada	6 (0.6)	19 (1.1)	49 (1.5)
New Zealand	3 (0.4)	11 (1.0)	34 (1.9)
Greece	3 (0.6)	10 (1.2)	29 (1.7)
Cyprus	2 (0.4)	8 (0.8)	29 (1.4)
Portugal	2 (0.4)	9 (0.9)	28 (1.7)
Norway	1 (0.3)	5 (0.8)	23 (1.5)
Iceland	1 (0.2)	3 (0.5)	16 (1.2)
Iran, Islamic Rep.	0 (0.0)	1 (0.3)	8 (1.2)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	12 (1.1)	26 (1.6)	55 (2.0)
Austria	10 (2.0)	25 (2.2)	56 (1.9)
[1] Latvia (LSS)	6 (1.2)	17 (1.6)	42 (2.2)
Netherlands	6 (0.6)	24 (1.4)	61 (1.7)
Scotland	5 (0.7)	16 (1.3)	41 (1.8)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	10 (0.9)	26 (1.6)	55 (1.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	10 (1.1)	25 (1.8)	51 (2.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
Thailand	2 (0.6)	10 (1.9)	35 (2.8)



The international levels correspond to the percentiles computed from the combined data from all of the participating countries.

Top 10% Level (90th Percentile) = 592
Top Quarter Level (75th Percentile) = 538
Top Half Level (50th Percentile) = 474

---

*Third grade in most countries; see Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE THE GENDER DIFFERENCES IN MATHEMATICS ACHIEVEMENT?

Tables 1.6 and 1.7 show the differences in achievement by gender. In most countries, girls and boys had approximately the same average mathematics achievement at both grades. However, the few significant differences in achievement that did exist in some countries favored boys rather than girls.

Each table presents mean mathematics achievement separately for boys and girls for each country, as well as the differences between the means. The visual representation of the gender difference for each country, shown by a bar, indicates the amount of the difference, whether the direction of the difference favors girls or boys, and whether or not the difference is statistically significant (indicated by a darkened bar).[9] Regardless of their directions, most of the differences were not statistically significant, indicating that, for most countries, gender differences in mathematics achievement generally are small or negligible in the primary years of schooling.

The few statistically significant differences that were observed favored boys rather than girls. At both grades, boys had significantly higher mathematics achievement than girls in Korea. Boys also outperformed girls at the fourth grade in Japan and the Netherlands. At the third grade, significant differences were found in Hong Kong, Canada, Iceland, Norway, and Slovenia.

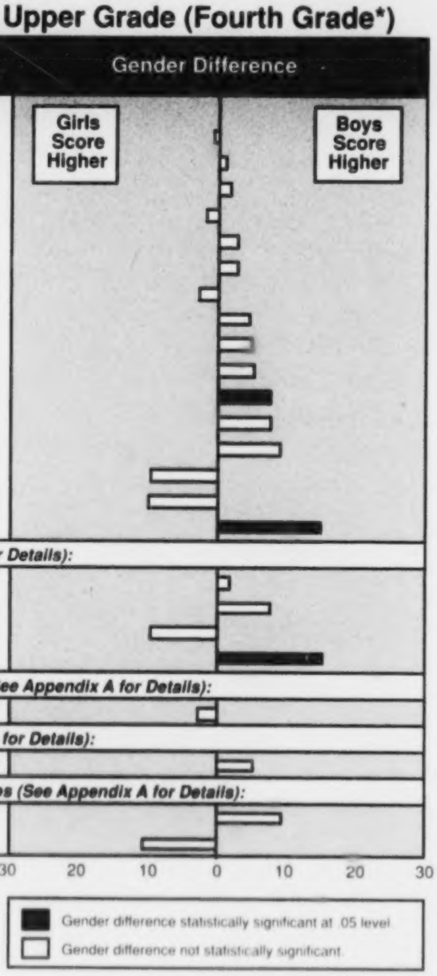
---

[9] The tests for statistical significance assumed independent samples of boys and girls in each country and have not been adjusted for multiple comparisons.

Table 1.6

Gender Differences in Mathematics Achievement - Upper Grade (Fourth Grade*)

Country	Boys Mean	Girls Mean	Difference Absolute Value
†Scotland	520 (4.3)	520 (3.8)	0 (5.8)
Hong Kong	586 (4.7)	587 (4.2)	1 (6.3)
Iceland	474 (3.3)	473 (3.0)	1 (4.5)
United States	545 (3.1)	544 (3.3)	2 (4.5)
Greece	491 (5.0)	493 (4.5)	2 (6.8)
Canada	534 (3.4)	531 (3.9)	3 (5.2)
Czech Republic	568 (3.4)	566 (3.6)	3 (5.0)
Ireland	548 (3.9)	551 (4.3)	3 (5.8)
Portugal	478 (3.8)	473 (3.7)	4 (5.3)
†2 England	515 (3.4)	510 (4.4)	5 (5.5)
Norway	504 (3.5)	499 (3.6)	5 (5.0)
Japan	601 (2.5)	593 (2.2)	8 (3.3)
Cyprus	506 (3.5)	499 (3.3)	8 (4.8)
Iran, Islamic Rep.	433 (6.0)	424 (5.0)	9 (7.8)
New Zealand	494 (5.7)	504 (4.3)	10 (7.1)
Singapore	620 (5.5)	630 (6.4)	10 (8.4)
Korea	618 (2.5)	603 (2.6)	15 (3.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	547 (3.5)	545 (3.7)	2 (5.1)
Austria	563 (3.6)	555 (3.6)	8 (5.1)
¹Latvia (LSS)	521 (5.5)	530 (5.2)	9 (7.5)
Netherlands	585 (3.8)	569 (3.4)	15 (5.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	551 (3.4)	554 (4.0)	3 (5.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	552 (4.2)	546 (3.9)	5 (5.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
¹Israel	537 (4.4)	528 (4.1)	9 (6.0)
Thailand	485 (5.8)	496 (4.2)	11 (7.1)



International Averages		
Boys	Girls	Difference
537	535	3

(Averages of all country means)

---

*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

²National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

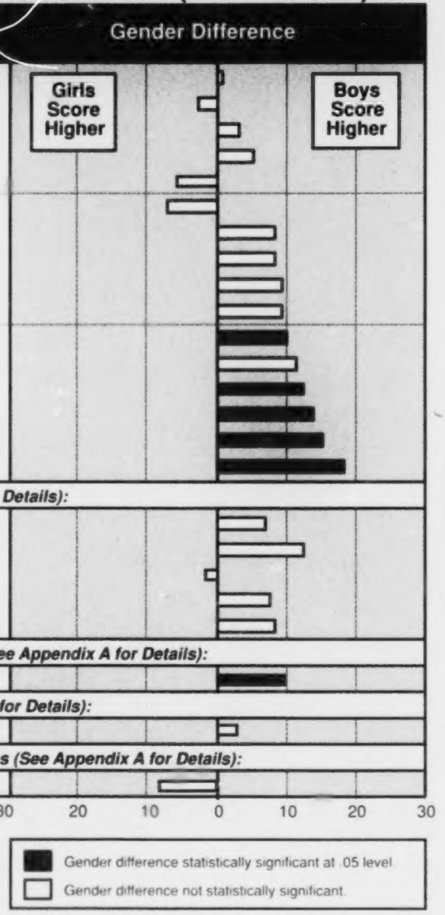
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 1.7

Gender Differences in Mathematics Achievement - Lower Grade (Third Grade*)

Country	Boys Mean	Girls Mean	Difference Absolute Value
United States	**480 (3.1)**	**479 (4.4)**	1 (5.4)
Singapore	551 (5.4)	553 (5.0)	3 (7.4)
Japan	539 (2.0)	536 (1.7)	3 (2.7)
Cyprus	433 (3.3)	428 (3.1)	5 (4.5)
Ireland	473 (4.3)	479 (4.5)	5 (6.3)
New Zealand	436 (4.4)	443 (4.5)	7 (6.3)
Greece	432 (4.4)	424 (4.2)	8 (6.0)
†2 England	461 (3.5)	452 (3.4)	8 (4.8)
Czech Republic	502 (3.7)	493 (3.8)	9 (5.3)
Portugal	430 (3.5)	420 (5.0)	10 (6.1)
Hong Kong	528 (3.2)	518 (3.5)	10 (4.8)
Iran, Islamic Rep.	384 (4.4)	373 (4.9)	12 (6.6)
Korea	567 (2.8)	554 (2.5)	13 (3.8)
Canada	477 (3.2)	463 (3.0)	14 (4.4)
Iceland	418 (3.5)	403 (3.0)	15 (4.7)
Norway	430 (3.5)	411 (3.8)	18 (5.2)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	487 (4.5)	480 (4.4)	7 (6.3)
Austria	494 (9.2)	481 (3.8)	12 (10.0)
1 Latvia (LSS)	462 (5.3)	464 (4.5)	2 (7.0)
Netherlands	497 (2.9)	489 (3.2)	8 (4.3)
Scotland	462 (3.8)	454 (3.5)	8 (5.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	492 (3.1)	483 (3.5)	10 (4.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	479 (4.9)	476 (4.4)	3 (6.6)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
Thailand	440 (5.0)	448 (5.6)	8 (7.5)



International Averages		
Boys	Girls	Difference
475	468	7

(Averages of all country means)

---

*Third grade in most countries; see Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE THE DIFFERENCES IN MEDIAN PERFORMANCE AT AGE 9?

For countries where the grades tested contained at least 75% of the 9-year-olds, TIMSS estimated the median performance for this age group. Table 1.8 provides this estimate as well as presenting estimates of the distribution of 9-year-olds across grades.[10] For many countries, the two grades tested included practically all of their 9-year-olds (seven countries have at least 98%), whereas, for some others, there were substantial percentages outside these grades, mostly in the grade below.[11] Of the countries included in Table 1.8, Iran, Austria, Latvia, and Hungary had 10% or more of their 9-year-olds below the two grades tested.

The median is the point on the mathematics scale that divides the higher-performing 50% of the students from the lower-performing 50%. Like the mean, the median provides a useful summary statistic on which to compare performance across countries. It is used instead of the mean in this table because it can be reliably estimated even when scores from some members of the population are not available[12] (that is, those 9-year-olds outside the tested grades).

Notwithstanding the additional difficulties in calculating the age-based achievement estimates, the results for 9-year-olds appear to be generally consistent with those obtained for the two grade levels. The relative performance of countries in mathematics achievement on the basis of median performance of 9-year-olds is quite similar to that based on average fourth-grade and/or third-grade performance. Despite some differences in relative standings, the higher-performing countries in the fourth and third grades generally were those with higher-performing 9-year-olds. For example, Singapore, Hong Kong, Korea, and Japan had the highest median performance at age 9. Similar to the fourth grade in particular, the 9-year-olds in the Netherlands also performed very well. Then, in a slightly different pattern, there is a cluster of countries with very similar median scores at age 9, including Canada, the United States, Scotland, the Czech Republic, and Australia.

---

[10] For information about the distribution of 9-year-olds in all countries, not just those with 75% coverage, see Table A.3 in Appendix A.

[11] The number of 9-year-olds below the lower grade and above the upper grade tested were extrapolated from the estimated distribution of 9-year-olds in the tested grades.

[12] Because TIMSS sampled students in the two adjacent grades with the most 9-year-olds within a country, it was possible to estimate the median for the 9-year-old students when the two tested grades included at least an estimated 75% of the 9-year-olds in that country. To compute the median, TIMSS assumed that those 9-year-old students in the grades below the tested grades would score below the median and those in the grades above the tested grades would score above the median. The percentages assumed to be above and below the median were added to the tails of the distribution before calculating the median using the modified distribution.

Table 1.8

Median Mathematics Achievement of 9-Year-Old Students
Includes Only Countries Where the Grades Tested Contained at Least 75% of the 9-Year-Olds

Country	Median	Country's Name For Lower Grade	Country's Name For Upper Grade	Estimated Distribution of 9-Year-Olds			
				Percent Below Lower Grade*	Percentage of 9-Year-Old Students Tested		
					Percent in Lower Grade	Percent in Upper Grade	
Singapore	**569 (5.0)**	Primary 3	Primary 4	2.1%	80.5%	17.4%	0.1%
Hong Kong	560 (4.1)	Primary 3	Primary 4	6.2%	43.2%	50.0%	0.7%
Korea	557 (2.5)	3rd Grade	4th Grade	7.9%	67.2%	24.3%	0.7%
Japan	544 (1.8)	3rd Grade	4th Grade	0.5%	90.8%	8.7%	0.0%
Canada	504 (2.7)	3	4	4.8%	46.3%	47.5%	1.3%
United States	503 (3.7)	3	4	4.5%	61.1%	34.2%	0.2%
[†] Scotland	502 (3.3)	Year 4	Year 5	0.3%	22.9%	75.7%	1.1%
Czech Republic	502 (3.5)	3	4	9.2%	75.5%	15.4%	0.0%
Ireland	489 (3.7)	3rd Class	4th Class	8.4%	68.4%	23.2%	0.0%
Greece	487 (3.5)	3	4	0.8%	10.9%	87.6%	0.7%
[†2] England	476 (3.1)	Year 4	Year 5	0.9%	57.8%	41.2%	0.1%
Cyprus	475 (3.2)	3	4	1.4%	35.1%	62.5%	0.9%
Norway	473 (3.7)	2	3	0.1%	38.1%	61.7%	0.1%
New Zealand	473 (4.4)	Standard 2	Standard 3	0.3%	50.2%	49.1%	0.3%
Iceland	463 (2.6)	3	4	0.4%	14.8%	84.4%	0.4%
Portugal	452 (3.9)	3	4	6.7%	45.0%	47.9%	0.4%
Iran, Islamic Rep.	385 (3.7)	3	4	16.9%	50.7%	32.0%	0.4%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):							
Australia	499 (3.6)	3 or 4	4 or 5	5.8%	64.9%	28.9%	0.4%
Austria	489 (3.2)	3	4	13.2%	71.5%	15.2%	0.0%
[1] Latvia (LSS)	446 (4.1)	3	4	23.8%	54.7%	21.2%	0.3%
Netherlands	512 (3.9)	5	6	6.9%	63.0%	30.1%	0.0%
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):							
Hungary	491 (4.4)	3	4	10.5%	70.2%	19.0%	0.3%

*Data are extrapolated; students below the lower grade and above the upper grade were not included in the sample.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

HOW DOES FOURTH-GRADE PERFORMANCE COMPARE WITH EIGHTH-GRADE PERFORMANCE?

Achievement at the third and fourth grades was estimated separately from achievement at the seventh and eighth grades. That is, different tests and content areas were used. Therefore, the scale scores are not comparable and direct comparisons cannot be made between the third and fourth grades on one hand and the seventh and eighth grades on the other. One way, however, to compare relative performance between the fourth grade and the eighth grade is to compare a country's performance with the international mean at each of the two grades. For example, the means for the countries participating at both grades are portrayed in Figure 1.3, with those for the eighth grade taken directly from *Mathematics in the Middle School Years: IEA's Third International Mathematics and Science Study*.[13]

As shown in Figure 1.3, Singapore, Korea, Japan, Hong Kong, the Netherlands, the Czech Republic, Austria, Slovenia, and Hungary were above the international average at both grades. However, the high-ranking countries at the fourth grade were not always the same as at the eighth grade. Ireland, Australia, and the United States were above the international average at the fourth grade. But, at the eighth grade, Ireland and Australia were about at the international average, while the United States was below it. Latvia (LSS) and Scotland performed similarly to the international average at the fourth grade, but below the international average at the eighth grade. Conversely, New Zealand and Thailand performed below the international average at the fourth grade, but not at the eighth grade.

In reading Figure 1.3, however, it is important to remember that the fourth- and eighth-grade scales are not directly comparable. For example, it is not the case that the eighth graders in Singapore outperformed the fourth graders by 18 points, nor is it true that fourth graders in Korea outperformed eighth graders by 4 points.

---

[13] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

Figure 1.3

Mathematics Performance at Fourth and Eighth Grades* Compared with the International Averages

Fourth Grade

Country	Mean Scale Score
Singapore	625 (5.3)
Korea	611 (2.1)
Japan	597 (2.1)
Hong Kong	587 (4.3)
Netherlands	577 (3.4)
Czech Republic	567 (3.3)
Austria	559 (3.1)
Slovenia	552 (3.2)
Ireland	550 (3.4)
Hungary	548 (3.7)
Australia	546 (3.1)
United States	545 (3.0)
Canada	532 (3.3)
Israel	531 (3.5)
Latvia (LSS)	525 (4.8)
Scotland	520 (3.9)
England	513 (3.2)
Cyprus	502 (3.1)
Norway	502 (3.0)
New Zealand	499 (4.3)
Greece	492 (4.4)
Thailand	490 (4.7)
Portugal	475 (3.5)
Iceland	474 (2.7)
Iran, Islamic Rep.	429 (4.0)
Kuwait	400 (2.8)

International Average = 529 (0.7)
(Average of All Country Means)

Eighth Grade

Country	Mean Scale Score
Singapore	643 (4.9)
Korea	607 (2.4)
Japan	605 (1.9)
Hong Kong	588 (6.5)
Czech Republic	564 (4.9)
Netherlands	541 (6.7)
Slovenia	541 (3.1)
Austria	539 (3.0)
Hungary	537 (3.2)
Australia	530 (4.0)
Ireland	527 (5.1)
Canada	527 (2.4)
Thailand	522 (5.7)
Israel	522 (6.2)
New Zealand	508 (4.5)
England	506 (2.6)
Norway	503 (2.2)
United States	500 (4.6)
Scotland	498 (5.5)
Latvia (LSS)	493 (3.1)
Iceland	487 (4.5)
Greece	484 (3.1)
Cyprus	474 (1.9)
Portugal	454 (2.5)
Iran, Islamic Rep.	428 (2.2)
Kuwait	392 (2.5)

International Average = 520 (0.8)
(Average of All Country Means)

● Significantly Higher than International Average

○ Not Significantly Different from International Average

◌ Significantly Lower than International Average

*Fourth and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Includes countries that participated in TIMSS testing at both fourth and eighth grades. The eighth-grade means are the same as those reported in *Mathematics Achievement in the Middle School Years: IEA's Third Mathematics and Science Study.*

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

In order to provide a more direct basis for comparison, TIMSS established a link between the results for the third- and fourth-grade students and the scale used to report seventh- and eighth-grade performance. Because 15 of the 102 mathematics items in the third- and fourth-grade assessment also were included in the seventh- and eighth-grade assessment, it was possible to use the average increase in performance on these items to estimate where on the seventh- and eighth-grade scale the younger students should be placed.[14]

Table 1.9 provides an estimate of how the fourth-grade students would have performed on the eighth-grade scale. The mean for fourth-grade students in this table is based on all items administered to fourth-grade students, although only the common items were used to establish the link. Since there were relatively few items in common in the mathematics tests given at the two grades, the size of the link is approximate. The standard error for the fourth-grade estimate incorporates an added component to account for the uncertainty of this approximation. (The eighth-grade means are the same as those reported in *Mathematics Achievement in the Middle School Years: IEA's Third Mathematics and Science Study*.)

Table 1.9 provides information about the difference in performance between the two grades. The estimated increases between the fourth and eighth grades were generally comparable for most countries, although there was a range from a low of 93 for the United States to a high of 168 for Thailand. For most countries, the differences in growth between the fourth and eighth grades are reflected in the changes in standing relative to the international mean as shown in Figure 1.3. For example, Thailand showed the largest increase, and its relative standing moved from below the international mean at the fourth grade to near the international mean at the eighth grade. A similar pattern was observed for New Zealand. In contrast, Australia, Ireland, Scotland, and Latvia (LSS) had smaller increases than many countries, and the United States had the smallest increase. These countries lost ground between the fourth and eighth grades in their standing relative to the international mean.

---

[14] See the section on "Estimating the Link Between Fourth- and Eighth-Grade Performance" in Appendix A.

Table 1.9

Increases in Mathematics Performance Between the Fourth and Eighth Grades* Based on Fourth-Grade Performance Estimated on the Eighth-Grade Scale

Country	Estimated Fourth-Grade Mean on Eighth-Grade Scale	Eighth-Grade Mean	Difference
Thailand	354 (9.1)	522 (5.7)	168 (10.7)
Singapore	484 (9.4)	643 (4.9)	159 (10.6)
Iceland	338 (8.3)	487 (4.5)	149 (9.5)
Japan	457 (8.1)	605 (1.9)	148 (8.3)
New Zealand	362 (8.9)	508 (4.5)	146 (10.0)
Hong Kong	447 (8.9)	588 (6.5)	141 (11.0)
Norway	365 (8.4)	503 (2.2)	138 (8.7)
Korea	471 (8.1)	607 (2.4)	137 (8.5)
Czech Republic	428 (8.5)	564 (4.9)	135 (9.8)
Iran, Islamic Rep.	294 (8.8)	428 (2.2)	134 (9.0)
Canada	395 (8.5)	527 (2.4)	133 (8.8)
England	376 (8.5)	506 (2.6)	130 (8.9)
Greece	356 (8.9)	484 (3.1)	128 (9.4)
Israel	394 (8.6)	522 (6.2)	128 (10.6)
Hungary	410 (8.7)	537 (3.2)	127 (9.2)
Slovenia	414 (8.5)	541 (3.1)	127 (9.0)
Kuwait	267 (8.3)	392 (2.5)	125 (8.7)
Australia	408 (8.4)	530 (4.0)	121 (9.3)
Austria	421 (8.4)	539 (3.0)	119 (9.0)
Ireland	412 (8.6)	527 (5.1)	116 (10.0)
Scotland	383 (8.7)	498 (5.5)	115 (10.3)
Portugal	340 (8.6)	454 (2.5)	115 (8.9)
Cyprus	366 (8.4)	474 (1.9)	108 (8.6)
Latvia (LSS)	388 (9.2)	493 (3.1)	105 (9.7)
Netherlands	438 (8.5)	541 (6.7)	103 (10.8)
United States	407 (8.4)	500 (4.6)	93 (9.6)

*Fourth and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures at the fourth grade (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Includes countries that participated in TIMSS achievement testing at both fourth and eighth grades.
Note: Table 1.9 provides an estimate of how the fourth-grade students would have performed on the eighth-grade scale. Since there are only 15 mathematics items in common in the tests given to the two grades, the estimate of the relationship is approximate. The standard error for the fourth-grade estimate incorporates an added component to account for the uncertainty of this approximation. The eighth-grade means are the same as those reported in *Mathematics Achievement in the Middle School Years: IEA's Third Mathematics and Science Study*.
Table C.5 contains the means for the third and fourth grades, as well as for the seventh and eighth grades.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Chapter 2

AVERAGE ACHIEVEMENT IN THE MATHEMATICS CONTENT AREAS

Recognizing that important curricular differences exist between and within countries is an important aspect of IEA studies, TIMSS attempted to measure achievement in different areas within mathematics that would be useful in relating achievement to curriculum. After much deliberation, the mathematics test for the third and fourth grades was designed to enable reporting by six content areas.[1] These six content areas consist of:

- whole numbers
- fractions and proportionality
- measurement, estimation, and number sense
- data representation, analysis, and probability
- geometry
- patterns, relations, and functions

Following the discussion in this chapter about differences in average achievement for the TIMSS countries across the content areas, Chapter 3 contains further information about the types of items within each content area, including five example items within each content area and the percentage of correct responses on those items for each of the TIMSS countries.

HOW DOES ACHIEVEMENT DIFFER ACROSS MATHEMATICS CONTENT AREAS?

As described in Chapter 1, there are substantial differences in achievement among the participating countries on the TIMSS mathematics test. Given that the mathematics test was designed to include items from different curricular areas, it is important to examine whether or not the participating countries have particular strengths and weaknesses in their achievement in these content areas.

This chapter uses an analysis based on the average percentage of correct responses to items within each content area to address whether countries performed at the same level in each of the content areas as they did on the mathematics test as a whole. Because additional resources and time would have been required to use the more complex IRT scaling methodology that served as the basis for the overall achievement estimates in Chapter 1, TIMSS could not generate scale scores for the six content areas for this report.[2]

---

[1] Please see the test development section of Appendix A for more information about the process used to develop the TIMSS tests. Appendix B provides an analysis of the match between the test and curriculum in the different TIMSS countries and the effect of this match on the TIMSS results.

[2] TIMSS plans to generate IRT scale scores for the mathematics content areas for future reports.

Tables 2.1 and 2.2 provide the average percentages of correct responses to items in the different content areas for the fourth- and third-grade students, respectively. The countries are listed in order of their average percent correct across all items in the test. As indicated by the numbers of items overall and in each content area, the overall test contains more items in the areas of whole numbers (25%), fractions (21%), and measurement (20%) and fewer items in the areas of data representation (12%), geometry (14%), and patterns (10%). Thus, countries that did well on the items testing the first three content areas were more likely to have higher overall scores than those that performed better in the second three content areas.[3]

The results for the average percent correct across all mathematics items are presented for each country primarily to provide a basis for comparison of performance in each of the content areas. For the purpose of comparing overall achievement among countries, it is preferable to use the results presented in Chapter 1.[4] It is interesting to note, however, that even though the relative standings of countries differ somewhat from Tables 1.1 and 1.2, the slight differences for most countries are well within the limits of sampling error and can be attributed to the differences in the methods used.

The major difference can be found in the relative standing of Singapore. Particularly at the fourth grade, a rather substantial percentage of students in Singapore answered all of the items in their booklets correctly – 7%. Although the scaling technology used in Chapter 1 takes these high-performing students into account in producing estimates of achievement distributions, the percentage correct metric does not. The percentage correct simply reflects how many students answered each of the TIMSS mathematics items correctly, on average. Although no other country had as large a percentage of students with perfect scores as Singapore, a number of countries had from 1% to 3%, including Australia, Austria, Cyprus, the Czech Republic, England, Hong Kong, Hungary, Ireland, Israel, Japan, Korea, Latvia, the Netherlands, Scotland, Slovenia, and the United States. At the third grade, this phenomenon occurred to a much lesser extent. Approximately 1% of the students in Singapore and Korea received perfect scores, while fewer than .5% did in almost every other country.

In Tables 2.1 and 2.2, the data in each column show each country's average percent correct for items in that content area and the international average across all countries for the content area (shown as the last entry in the column). Looking down each of the columns, in turn, two findings become apparent. First, the countries that did well on the overall test generally did well in each of the various content areas, and those that did poorly overall also tended to do so in each of the content areas. There are differences between the relative standing of countries within each of the content areas and their overall standing, but these differences are small when sampling error is considered.

---

[3] Table A.1 in Appendix A provides details about the distributions of items across the content areas, by format and score points (taking into account multi-part items and items scored for partial credit).

[4] The IRT scale scores provide better estimates of overall achievement, because they take the difficulty of items into account. This is important in a study such as TIMSS, where different students take overlapping but somewhat different sets of items.

Table 2.1

Average Percent Correct by Mathematics Content Areas Upper Grade (Fourth Grade*)

Country	Mathematics Overall (102 items)	Whole Numbers (25 items)	Fractions and Proportionality (21 items)	Measurement Estimation, and Number Sense (20 items)	Data Representation Analysis, and Probability (12 items)	Geometry (14 items)	Patterns, Relations, and Functions (10 items)
Korea	76 (0.4)	88 (0.3)	65 (0.5)	72 (0.5)	80 (0.6)	72 (0.6)	83 (0.7)
Singapore	76 (0.8)	83 (0.7)	74 (1.0)	67 (1.0)	81 (0.8)	72 (0.8)	76 (0.9)
Japan	74 (0.4)	82 (0.4)	65 (0.6)	72 (0.5)	79 (0.5)	72 (0.6)	76 (0.6)
Hong Kong	73 (0.9)	79 (0.9)	66 (1.0)	69 (0.9)	76 (1.0)	74 (0.8)	73 (1.2)
Czech Republic	66 (0.6)	75 (0.6)	53 (0.8)	68 (0.7)	67 (0.9)	71 (0.7)	67 (0.9)
Ireland	63 (0.8)	70 (0.8)	58 (1.0)	56 (0.9)	69 (0.9)	66 (0.8)	64 (1.0)
United States	63 (0.6)	71 (0.7)	51 (0.8)	53 (0.6)	73 (0.9)	71 (0.7)	66 (0.9)
Canada	60 (1.0)	68 (0.9)	48 (1.0)	54 (1.1)	68 (1.4)	72 (1.4)	62 (1.5)
[†] Scotland	58 (0.8)	61 (0.8)	46 (1.0)	53 (0.9)	66 (1.0)	72 (0.8)	57 (1.0)
[†2] England	57 (0.7)	58 (0.7)	45 (0.8)	52 (0.7)	64 (0.9)	74 (0.8)	55 (1.0)
Cyprus	54 (0.6)	65 (0.7)	48 (0.7)	48 (0.8)	52 (0.9)	53 (0.9)	55 (1.1)
Norway	53 (0.7)	61 (0.8)	38 (0.7)	56 (0.7)	59 (0.9)	58 (0.9)	50 (1.2)
New Zealand	53 (1.0)	57 (1.0)	41 (1.1)	49 (1.1)	61 (1.3)	66 (1.1)	52 (1.2)
Greece	51 (0.9)	62 (1.0)	42 (1.1)	48 (1.0)	50 (1.2)	53 (1.2)	47 (1.2)
Iceland	50 (0.8)	56 (0.9)	36 (1.0)	44 (0.9)	58 (1.2)	63 (1.0)	48 (1.4)
Portugal	48 (0.7)	57 (0.8)	38 (0.7)	49 (0.8)	43 (1.1)	52 (1.0)	47 (1.1)
Iran, Islamic Rep.	38 (0.9)	51 (1.2)	32 (1.0)	36 (0.9)	23 (0.9)	42 (0.9)	40 (1.4)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):							
Australia	63 (0.6)	67 (0.6)	51 (0.7)	60 (0.7)	67 (0.8)	74 (0.7)	64 (0.9)
Austria	65 (0.7)	74 (0.8)	51 (0.8)	69 (0.8)	66 (1.1)	67 (0.8)	64 (1.1)
[1] Latvia (LSS)	59 (1.0)	68 (0.9)	44 (1.3)	60 (1.0)	54 (1.3)	67 (1.0)	65 (1.2)
Netherlands	69 (0.7)	75 (0.8)	60 (0.9)	70 (0.8)	75 (0.9)	71 (0.8)	65 (1.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):							
Slovenia	64 (0.6)	74 (0.6)	50 (0.9)	64 (0.9)	64 (1.0)	72 (0.8)	68 (0.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):							
Hungary	64 (0.8)	76 (0.7)	49 (0.9)	64 (0.9)	60 (1.0)	66 (0.8)	69 (1.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):							
[1] Israel	59 (1.0)	71 (1.0)	48 (1.1)	54 (1.0)	64 (1.2)	62 (1.0)	60 (1.5)
Kuwait	32 (0.5)	36 (0.5)	25 (0.5)	35 (0.6)	26 (0.6)	36 (0.6)	33 (1.0)
Thailand	50 (1.1)	58 (1.3)	44 (1.0)	44 (1.0)	56 (1.5)	53 (1.2)	50 (1.3)
International Average Percent Correct	59 (0.2)	67 (0.2)	49 (0.2)	56 (0.2)	62 (0.2)	64 (0.2)	60 (0.2)

[*] Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 2.2

Average Percent Correct by Mathematics Content Areas Lower Grade (Third Grade*)

Country	Mathematics Overall (102 items)	Whole Numbers (25 items)	Fractions and Proportionality (21 items)	Measurement, Estimation, and Number Sense (20 items)	Data Representation, Analysis, and Probability (12 items)	Geometry (14 items)	Patterns, Relations, and Functions (10 items)
Korea	**67 (0.5)**	**81 (0.5)**	**53 (0.6)**	**61 (0.6)**	**70 (0.8)**	**67 (0.6)**	**73 (0.7)**
Japan	63 (0.3)	72 (0.4)	52 (0.5)	60 (0.5)	69 (0.5)	62 (0.6)	64 (0.6)
Singapore	62 (0.9)	75 (0.8)	55 (1.0)	52 (1.0)	68 (1.1)	60 (0.8)	65 (1.1)
Hong Kong	59 (0.7)	68 (0.7)	48 (0.8)	56 (0.8)	63 (1.0)	65 (0.8)	58 (1.0)
Czech Republic	52 (0.7)	59 (0.8)	38 (0.8)	54 (0.7)	51 (1.0)	61 (0.8)	53 (1.0)
United States	49 (0.7)	57 (0.7)	36 (0.8)	41 (0.8)	56 (1.0)	61 (0.9)	53 (1.1)
Ireland	48 (0.8)	55 (0.9)	41 (1.0)	41 (0.7)	50 (1.2)	55 (0.9)	48 (1.1)
Canada	47 (0.7)	53 (0.7)	33 (0.8)	42 (0.7)	52 (1.0)	62 (1.0)	48 (1.3)
†2 England	45 (0.6)	46 (0.8)	34 (0.6)	42 (0.7)	50 (1.0)	63 (0.9)	43 (1.0)
New Zealand	41 (0.8)	42 (1.0)	30 (0.7)	38 (0.8)	43 (1.2)	58 (1.2)	41 (1.2)
Cyprus	38 (0.6)	48 (0.7)	31 (0.7)	35 (0.7)	33 (0.8)	42 (0.8)	41 (1.0)
Portugal	37 (0.8)	46 (1.0)	30 (0.7)	37 (0.8)	31 (1.1)	42 (1.0)	36 (1.3)
Greece	37 (0.8)	46 (1.0)	30 (0.9)	36 (1.0)	35 (1.0)	41 (0.9)	33 (1.3)
Norway	36 (0.7)	40 (0.9)	24 (0.6)	38 (0.9)	37 (1.0)	44 (0.9)	34 (1.1)
Iceland	35 (0.6)	37 (0.8)	25 (0.6)	33 (0.8)	39 (1.0)	50 (1.1)	32 (1.1)
Iran, Islamic Rep.	28 (0.7)	38 (1.1)	20 (0.5)	29 (0.8)	17 (0.7)	33 (0.9)	30 (1.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):							
Australia	50 (0.9)	54 (1.0)	38 (0.9)	48 (0.8)	51 (1.2)	65 (1.2)	50 (1.1)
Austria	50 (1.0)	58 (0.8)	35 (1.1)	55 (1.2)	48 (1.4)	57 (1.3)	48 (1.4)
1 Latvia (LSS)	45 (0.8)	50 (1.0)	30 (0.9)	48 (1.0)	39 (1.1)	57 (1.0)	53 (1.4)
Netherlands	52 (0.6)	57 (0.7)	39 (0.6)	54 (0.7)	56 (1.0)	61 (0.8)	50 (1.2)
Scotland	45 (0.8)	47 (0.9)	33 (0.6)	41 (0.9)	49 (1.1)	65 (0.9)	45 (1.1)
Countries Not Meeting Age Grade Specifications (High Percentage of Older Students; See Appendix A for Details):							
Slovenia	51 (0.7)	60 (0.8)	36 (0.7)	47 (0.8)	52 (1.0)	64 (0.7)	54 (1.3)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):							
Hungary	49 (0.9)	62 (1.0)	34 (0.8)	47 (0.9)	45 (1.0)	52 (1.0)	57 (1.3)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):							
Thailand	40 (1.2)	47 (1.4)	33 (1.2)	35 (1.0)	41 (1.7)	44 (1.4)	40 (1.5)
International Average Percent Correct	47 (0.2)	54 (0.2)	36 (0.2)	45 (0.2)	48 (0.2)	56 (0.2)	48 (0.2)

*Third grade in most countries; see Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Second, the international averages show that the different content areas in the TIMSS test were not equally difficult for the students taking the test. Whole numbers and geometry were the least difficult content areas. At the fourth-grade, on average, the whole number items were answered correctly by 67% of the students across countries, and the geometry items by 64% of the students. At the third grade, the international averages were 54% in whole numbers and 56% in geometry. Internationally, the fractions and proportionality items (international averages of 49% at fourth grade and 36% at third grade) were the most difficult items for the students at both grades.

It is important to keep these differences in average difficulty in mind when reading across the rows of the table. These differences mean that for many countries, students will appear to have higher than average performance in whole numbers and geometry and lower than average performance in fractions and proportionality. For example, even the fourth-grade students in Korea, Singapore, Japan, and Hong Kong who performed above the international average for the area of fractions and proportionality by a substantial margin, still performed somewhat less well in this area than they did on the test as a whole. That is, simply comparing performance across the rows gives an unclear picture of each country's relative performance across the content areas because the differing difficulty of the items has not been taken into account.

To facilitate more meaningful comparisons across rows, TIMSS has developed profiles of relative performance, which are shown for both grades in Table 2.3. These profiles are designed to show whether participating countries performed better or worse in some content areas than they did on the test as a whole, after adjusting for the differing difficulty of the items in each of the content areas.[5] An up-arrow indicates that a country performed significantly better in a content area than it did on the test as a whole, a down-arrow indicates significantly lower performance, and a circle indicates that the country's performance in a content area is not very different from its performance on the test as a whole.[6]

The profiles in Table 2.3 reveal that many countries performed relatively better or worse in several content areas than they did overall. Each country had at least two content areas in which it did either relatively better or worse than it did on average. Although countries that did well in one content area tended to do well in others, there were still significant performance differences by content area among countries. Also, although there were differences between the two grades, relative performance tended to be similar at both the third and fourth grades. That countries have different relative strengths and weaknesses is consistent with the existence of differing curricular patterns and approaches among countries as discussed in the curriculum analysis report, *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*.[7]

---

[5] In performing the computations, the first step was to adjust the average percents to make all content areas equally difficult so that the comparisons would not reflect the various difficulties of the items in the content areas. The next step was to subtract these adjusted percentages for each content area from a country's average percentage over all six content areas. If the overall percentage of correct items by students in a country was the same as the adjusted average for that country for each of the content areas, then these differences would all be zero. The standard errors for these differences were computed, and then each difference was examined for statistical significance. This approach is similar to testing interaction terms in the analysis of variance. The jackknife method was used to compute the standard error of each interaction term. The significance level was adjusted using the Bonferroni method, assuming 6 x 26 (content areas by countries) comparisons at the fourth grade and 6 x 24 at the third grade.

[6] The statistics are not independent. That is, a country cannot do better (or worse) than its average on all scales, since a country's differences must add up to zero. However, it is possible for a country to have no statistically significant differences in performance.

[7] Schmidt, W.H., McKnight, C.C., Valverde, G.A., Houang, R.T., and Wiley, D.E. (1997). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics.* Dordrecht, the Netherlands: Kluwer Academic Publishers.

Table 2.3

Profiles of Relative Performance in Mathematics Content Areas - Lower and Upper Grades (Third and Fourth Grades*)

Third Grade							Fourth Grade						
Country	Whole Numbers	Fractions and Proportionality	Measurement, Estimation, and Number Sense	Data Representation, Analysis, & Probability	Geometry	Patterns, Relations, and Functions	Country	Whole Numbers	Fractions and Proportionality	Measurement, Estimation, and Number Sense	Data Representation, Analysis, & Probability	Geometry	Patterns, Relations, and Functions
Korea	▲	▼	▼	▲	▼	▲	Korea	▲	●	▼	●	▼	▲
Japan	▲	●	●	▲	▼	●	Singapore	●	▲	▼	▲	▼	●
Singapore	▲	▲	▼	▲	▼	▲	Japan	●	▲	▲	▲	▼	▲
Hong Kong	▲	●	●	▲	▼	▼	Hong Kong	▼	▲	●	●	▼	●
Czech Republic	●	▼	▲	●	●	●	Czech Republic	●	▼	▲	●	●	●
United States	●	▼	▼	▲	▲	●	Ireland	●	▲	▼	▲	▼	●
Ireland	●	▲	▼	●	●	●	United States	●	▼	▼	▲	▲	▲
Canada	▼	▼	▼	▲	▲	●	Canada	●	▼	▼	▲	▲	●
†2 England	▼	●	●	▲	▲	▼	† Scotland	▼	▼	▼	▲	▲	▼
New Zealand	▼	●	●	●	▲	●	†2 England	▼	▼	▼	▲	▲	▼
Cyprus	▲	▲	●	▼	▼	●	Cyprus	▲	▲	▼	▼	▼	●
Portugal	▲	▲	▲	▼	▼	●	Norway	●	▼	▲	▲	●	▼
Greece	▲	▲	●	▼	▼	▼	New Zealand	▼	▼	▼	▲	▲	●
Norway	▼	●	▲	●	●	▼	Greece	▲	▲	●	▼	●	▼
Iceland	▼	●	●	▲	▲	▼	Iceland	▼	▼	▼	▲	▲	●
Iran, Islamic Rep.	▲	▲	▲	▼	▼	●	Portugal	▲	●	▲	▼	●	●
							Iran, Islamic Rep.	▲	▲	▲	▼	●	●
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):													
Australia	▼	●	●	●	▲	●	Australia	▼	▼	●	●	▲	●
Austria	●	▼	▲	●	●	●	Austria	●	▼	▲	●	▼	●
¹ Latvia (LSS)	▼	▼	▲	▼	●	▲	¹ Latvia (LSS)	●	▼	▲	▼	▲	▲
Netherlands	▼	▼	▲	▲	●	●	Netherlands	●	●	▲	▲	▼	▼
Scotland	▼	▼	▼	●	▲	●							
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):													
Slovenia	●	▼	▼	●	▲	●	Slovenia	●	▼	▲	▼	●	▲
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):													
Hungary	▲	▼	●	▼	▼	▲	Hungary	▲	▼	▲	▼	▼	▲
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):													
Thailand	●	▲	●	●	▼	●	¹ Israel	▲	●	▼	▲	▼	●
							Kuwait	▼	▲	▲	▼	●	●
							Thailand	●	▲	▼	▲	▼	●

▲ = Significantly higher than the country's overall average performance after adjusting for the difficulty of the content area

● = No significant difference from the country's overall average performance after adjusting for the difficulty of the content area

▼ = Significantly lower than the country's overall average performance after adjusting for the difficulty of the content area

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE THE INCREASES IN ACHIEVEMENT BETWEEN THE LOWER AND UPPER GRADES?

Figure 2.1, which profiles the increases in average percent correct between the third and fourth grade for each country across content areas, also reflects these curricular differences. The figure portrays the amount of the increase in mathematics achievement overall as well as the increase in achievement for each of the six content areas. The dashed line indicates the overall increase, for ease in comparing the growth within content areas with the growth in performance overall.

The results are presented in descending order by the amount of overall increase between the grades, beginning with Norway, Cyprus, and Ireland, all three of which showed the greatest increases (15 percentage points or more). Since students in Norway begin school at a later age than those in the other participating countries, its 9-year-olds were generally in the second and third grades rather than the third and fourth grades. Not surprisingly, staff from the TIMSS national research center in Norway reported that the second graders had difficulty in reading some of the items, and that the improvements in reading literacy skills from second to third grade undoubtedly accounted for part of the large increase in Norway.

Consistent with the scale scores presented in Chapter 1, for most countries the overall increase in average percent correct between the third and fourth grades was larger than that observed between the seventh and eighth grades.[8] The increases between seventh and eighth grades ranged from approximately 1 to 10 percentage points.

The results show that the degree of increase across the different content areas was uneven in most countries, generally reflecting a greater emphasis in the curriculum on some areas than others during the fourth grade. However, there were several countries, Greece, England, Japan, Portugal, and Hungary, for example, where the increases in the content areas were similar to the overall between-grade increase across most content areas.

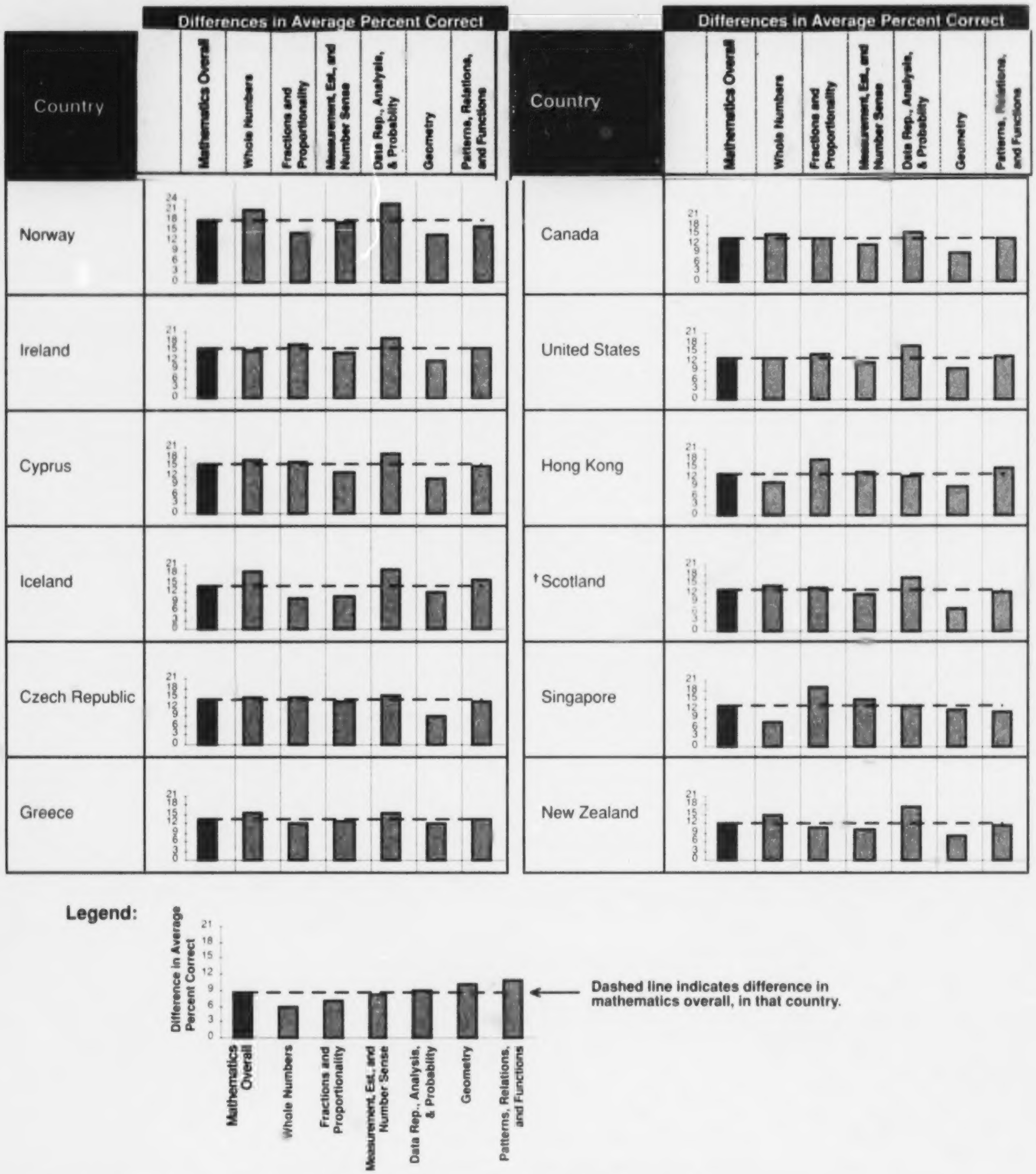
---

[8] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

In general, performance in data representation, analysis, and probability showed the largest growth between the third and fourth grades. Growth also was found in either whole numbers or fractions and proportionality. This is most noticeable in whole numbers for Norway, Iceland, and Latvia. Hong Kong, Singapore, Korea, and the Netherlands, four of the highest performing countries, were among those countries showing higher-than-average between-grade increases in fractions and proportionality. The growth in measurement, estimation, and number sense tended to be quite similar to or somewhat below the average between-grade increase, except in Slovenia and Hungary. In general, the increases in patterns, relations, and functions were very similar to the increases overall. Geometry often showed a smaller-than-average increase compared with that overall, presumably because this content area is not particularly emphasized in either third or fourth grade.

Figure 2.1

Difference in Average Percent Correct Between Lower and Upper Grades (Third and Fourth Grades*) Overall and in Mathematics Content Areas



---

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

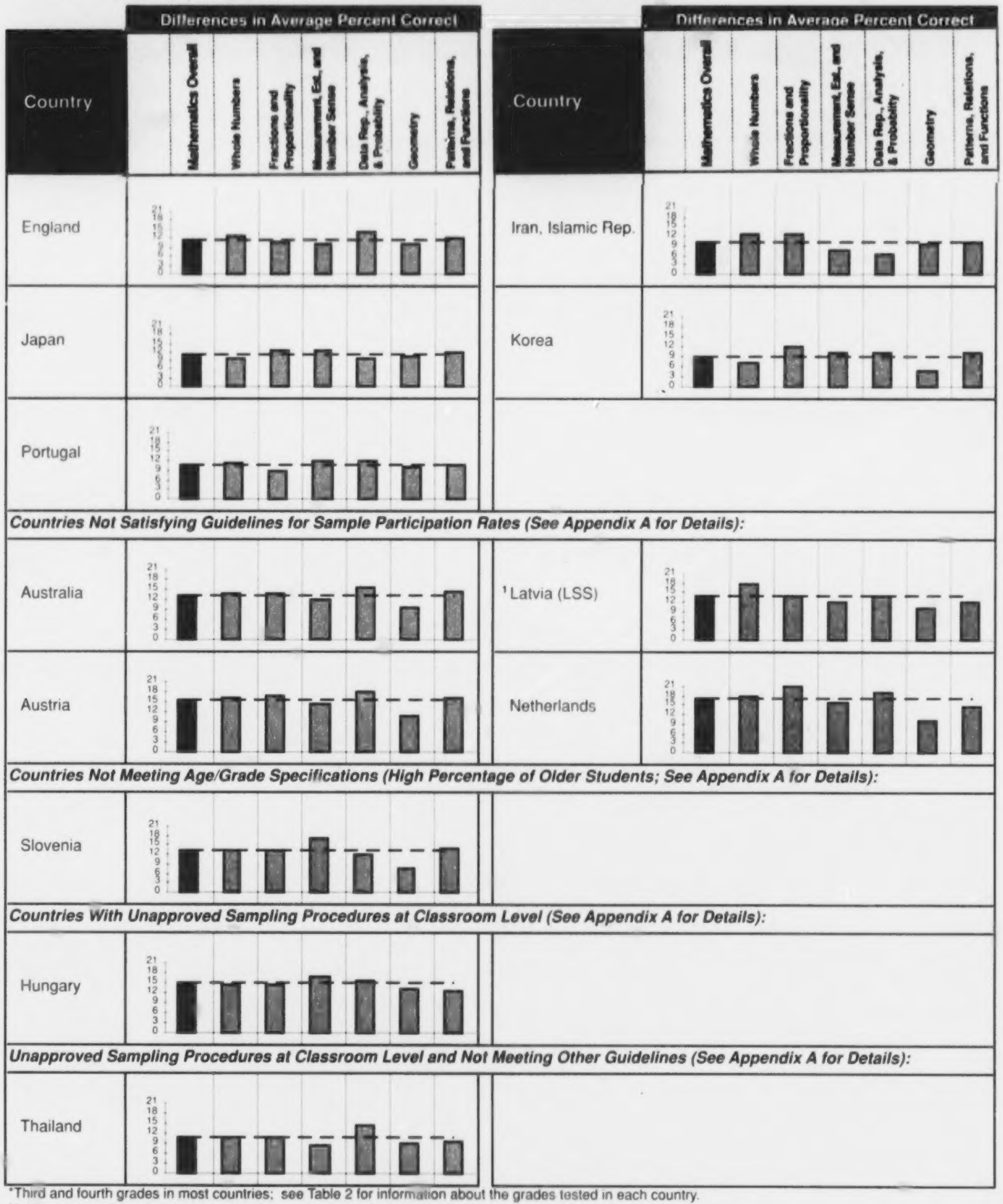
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 2.1 (Continued)

Difference in Average Percent Correct Between Lower and Upper Grades (Third and Fourth Grades*) Overall and in Mathematics Content Areas



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE THE GENDER DIFFERENCES IN ACHIEVEMENT FOR THE CONTENT AREAS?

Tables 2.4 and 2.5 indicate few statistically significant gender differences in achievement overall. The results are nearly identical to those in Chapter 1. However, the slightly reduced number of gender differences in performance overall compared to the differences in scale scores discussed in Chapter 1 reinforces the idea of less precision in the percent-correct metric. Still, the findings are consistent: few gender differences, but the differences that do exist tend to favor boys. In the content areas, especially at the third grade, boys tended to have higher achievement than girls in a number of countries in whole numbers and in fractions and proportionality, as well as in measurement, estimation, and number sense. For the remaining three content areas, there were few differences in performance between boys and girls.

In whole numbers, the fourth-grade boys had significantly higher achievement than the girls in England, Japan, and Korea. The fourth-grade girls outperformed the boys in Singapore. However, at the third grade, the boys had higher achievement than the girls in Canada, England, Iceland, Japan, Korea, Norway, and the Netherlands. In fractions and proportionality, the gender differences at the fourth grade were minimal in all countries except Korea and Austria where boys had significantly higher achievement than girls. The third-grade boys showed a significant advantage in the Czech Republic, Hong Kong, Iceland, and Korea. In the area of measurement, estimation, and number sense, gender differences favoring boys over the girls were found in more than one-third of the countries at either the fourth or third grades. The advantage for boys was observed in several countries at both grades, including the Czech Republic, England, Iran, Japan, Korea, and Norway. In no country did the girls have higher achievement than the boys in this content area.

Boys and girls at both grades performed about the same in the content area of data representation, analysis, and probability. The exceptions were New Zealand and Thailand, where the fourth-grade girls performed significantly better than the boys did, and Cyprus and Iceland, where the third-grade boys outperformed the girls. Similarly, there were few gender differences in geometry. The boys had higher achievement than the girls in the Netherlands at the fourth grade and in Korea at the third grade. The girls had higher achievement than the boys in New Zealand at the fourth and third grades and in Ireland at the third grade. The only differences in the area of patterns, relations, and functions were in New Zealand, where the girls outperformed the boys at both grades, and in the Czech Republic, where the third-grade boys had significantly higher achievement than the girls did. (The Second International Mathematics Study did not include students in the lower grades, so comparisons are not possible. In the International Assessment of Educational Progress, content area results were not reported by gender, but the overall results showed few differences.[9])

---

[9] Lapointe, A.E., Mead, N.A., and Askew, J.M. (1992). *Learning Mathematics.* Princeton, NJ: Educational Testing Service.

Table 2.4

Average Percent Correct for Boys and Girls by Mathematics Content Areas Upper Grade (Fourth Grade*)

Country	Mathematics Overall		Whole Numbers		Fractions and Proportionality		Measurement, Estimation, and Number Sense	
Canada	61 (1.1)	60 (1.2)	69 (0.8)	66 (1.3)	47 (1.1)	48 (1.2)	55 (1.1)	53 (1.3)
Cyprus	55 (0.8)	53 (0.7)	66 (0.9)	64 (0.9)	49 (0.9)	47 (0.8)	▲ 49 (1.1)	46 (0.8)
Czech Republic	67 (0.7)	66 (0.7)	75 (0.8)	74 (0.6)	53 (1.0)	52 (0.9)	▲ 69 (0.8)	67 (0.8)
†2England	57 (0.8)	56 (0.9)	▲ 60 (0.9)	57 (1.0)	46 (1.1)	45 (1.2)	▲ 54 (0.9)	50 (1.0)
Greece	50 (1.2)	51 (0.9)	61 (1.4)	63 (0.9)	42 (1.3)	42 (1.1)	49 (1.2)	48 (1.0)
Hong Kong	73 (1.1)	73 (0.8)	79 (1.1)	79 (0.9)	67 (1.1)	66 (1.0)	69 (1.2)	69 (0.7)
Iceland	50 (1.0)	49 (0.9)	58 (1.2)	55 (1.0)	36 (1.1)	35 (1.1)	44 (1.1)	44 (1.2)
Iran, Islamic Rep.	39 (1.4)	37 (1.1)	52 (1.9)	49 (1.5)	32 (1.3)	32 (1.4)	▲ 38 (1.4)	34 (1.1)
Ireland	63 (0.9)	64 (0.9)	70 (0.9)	70 (1.1)	57 (1.1)	59 (1.2)	57 (1.1)	55 (1.1)
Japan	75 (0.5)	74 (0.5)	▲ 83 (0.5)	81 (0.5)	66 (0.8)	65 (0.6)	▲ 73 (0.6)	71 (0.6)
Korea	▲ 77 (0.4)	75 (0.5)	▲ 89 (0.4)	87 (0.5)	▲ 66 (0.7)	63 (0.7)	▲ 73 (0.7)	70 (0.7)
New Zealand	52 (1.3)	54 (0.9)	57 (1.5)	57 (1.1)	41 (1.5)	42 (1.0)	48 (1.3)	49 (1.2)
Norway	54 (0.9)	53 (0.8)	62 (1.0)	61 (1.1)	39 (1.0)	38 (0.8)	▲ 57 (1.0)	54 (1.1)
Portugal	48 (0.8)	48 (0.8)	57 (1.0)	57 (0.9)	38 (0.9)	38 (0.7)	50 (0.9)	49 (1.0)
†Scotland	58 (0.9)	58 (0.9)	61 (1.0)	61 (1.0)	46 (1.2)	47 (1.2)	54 (1.0)	53 (1.1)
Singapore	75 (0.9)	76 (1.0)	81 (0.8)	▲ 84 (0.8)	73 (1.0)	75 (1.2)	67 (1.0)	66 (1.3)
United States	63 (0.7)	62 (0.7)	71 (0.7)	70 (0.8)	51 (0.9)	50 (0.8)	▲ 54 (0.7)	52 (0.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):								
Australia	63 (0.7)	63 (0.8)	68 (0.9)	67 (0.8)	51 (0.8)	51 (1.0)	60 (0.8)	59 (0.9)
Austria	66 (0.9)	64 (0.8)	74 (0.9)	74 (0.9)	▲ 53 (1.1)	50 (1.0)	71 (1.1)	68 (1.0)
¹Latvia (LSS)	58 (1.2)	60 (1.1)	66 (1.1)	69 (1.1)	43 (1.5)	44 (1.4)	60 (1.3)	61 (1.2)
Netherlands	▲ 71 (0.8)	68 (0.8)	76 (0.9)	74 (1.0)	61 (1.1)	59 (1.0)	▲ 72 (0.8)	68 (1.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):								
Slovenia	64 (0.7)	65 (0.9)	73 (0.7)	75 (0.8)	51 (1.1)	49 (1.2)	65 (1.0)	63 (1.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):								
Hungary	64 (0.8)	64 (0.9)	77 (0.9)	76 (0.9)	50 (1.0)	49 (1.1)	65 (1.0)	63 (1.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):								
¹Israel	60 (1.1)	59 (1.0)	71 (1.1)	71 (1.1)	48 (1.2)	47 (1.2)	▲ 57 (1.4)	52 (1.1)
Thailand	49 (1.3)	52 (1.0)	57 (1.5)	60 (1.4)	42 (1.3)	45 (1.1)	44 (1.3)	43 (1.2)

▲ = Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

---

*Fourth grade in most countries. See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

²National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 2.4 (Continued)

Average Percent Correct for Boys and Girls by Mathematics Content Areas – Upper Grade (Fourth Grade*)

Country	Data Representation, Analysis, and Probability		Geometry		Patterns, Relations, and Functions	
Canada	67 (1.6)	69 (1.4)	72 (1.3)	72 (1.6)	62 (1.6)	60 (2.1)
Cyprus	53 (1.1)	52 (1.1)	52 (1.2)	53 (1.1)	57 (1.2)	54 (1.6)
Czech Republic	67 (1.1)	67 (1.1)	71 (0.9)	71 (0.8)	67 (1.1)	66 (1.1)
†2 England	64 (1.2)	65 (1.2)	74 (0.9)	74 (1.0)	56 (1.4)	54 (1.2)
Greece	48 (1.6)	51 (1.4)	53 (1.8)	54 (1.1)	46 (1.8)	48 (1.3)
Hong Kong	75 (1.2)	77 (1.0)	75 (0.9)	74 (1.1)	71 (1.5)	75 (1.2)
Iceland	59 (1.7)	58 (1.3)	62 (1.3)	63 (1.2)	49 (1.8)	48 (1.6)
Iran, Islamic Rep.	25 (1.5)	22 (0.8)	42 (1.4)	43 (1.2)	40 (2.0)	40 (1.8)
Ireland	68 (1.2)	70 (1.1)	66 (1.0)	67 (1.0)	64 (1.4)	63 (1.1)
Japan	79 (0.7)	79 (0.7)	73 (0.8)	72 (0.7)	77 (0.7)	76 (0.8)
Korea	80 (0.8)	79 (0.8)	72 (0.8)	71 (0.8)	84 (0.9)	82 (1.1)
New Zealand	58 (1.8)	▲ 64 (1.4)	64 (1.5)	▲ 69 (1.2)	50 (1.5)	▲ 55 (1.4)
Norway	59 (1.2)	60 (1.1)	57 (1.2)	58 (1.1)	49 (1.5)	51 (1.7)
Portugal	43 (1.1)	43 (1.3)	52 (1.2)	52 (1.2)	49 (1.3)	46 (1.4)
† Scotland	65 (1.3)	67 (1.2)	72 (1.0)	73 (0.9)	58 (1.4)	57 (1.2)
Singapore	80 (0.9)	82 (1.0)	71 (0.9)	73 (1.0)	76 (1.0)	76 (1.2)
United States	72 (1.1)	74 (1.0)	71 (0.7)	71 (0.9)	67 (1.1)	66 (1.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):						
Australia	66 (1.0)	68 (1.0)	73 (0.8)	75 (1.0)	65 (1.2)	63 (1.2)
Austria	67 (1.5)	66 (1.4)	68 (0.9)	67 (1.0)	65 (1.5)	64 (1.8)
1 Latvia (LSS)	52 (1.5)	55 (1.6)	65 (1.3)	68 (1.2)	64 (1.7)	67 (1.2)
Netherlands	76 (1.0)	75 (1.3)	▲ 73 (1.0)	69 (0.9)	65 (1.3)	66 (1.5)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):						
Slovenia	64 (1.1)	64 (1.3)	71 (1.1)	73 (1.0)	67 (1.3)	69 (1.1)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):						
Hungary	60 (1.3)	61 (1.3)	67 (1.0)	65 (1.2)	68 (1.2)	71 (1.4)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):						
1 Israel	65 (1.5)	64 (1.3)	61 (1.3)	63 (1.0)	60 (1.5)	61 (1.8)
Thailand	53 (1.8)	▲ 59 (1.5)	52 (1.6)	54 (1.2)	48 (1.8)	51 (1.2)

▲ = Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

---

*Fourth grade in most countries; See Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 2.5

Average Percent Correct for Boys and Girls by Mathematics Content Areas Lower Grade (Third Grade*)

Country	Mathematics Overall		Whole Numbers		Fractions and Proportionality		Measurement, Estimation, and Number Sense	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Canada	▲ 48 (0.7)	46 (0.8)	▲ 55 (0.9)	51 (0.8)	34 (0.7)	33 (1.0)	▲ 44 (0.8)	40 (1.0)
Cyprus	39 (0.7)	38 (0.7)	49 (0.9)	47 (0.9)	32 (0.8)	31 (0.7)	▲ 36 (0.8)	34 (0.7)
Czech Republic	53 (0.8)	51 (0.9)	61 (1.0)	58 (1.0)	▲ 39 (0.9)	36 (1.0)	▲ 56 (1.0)	52 (0.9)
[†2]England	46 (0.7)	44 (0.7)	▲ 47 (0.9)	44 (0.9)	35 (0.8)	34 (0.7)	▲ 43 (1.0)	40 (0.8)
Greece	38 (1.0)	36 (0.9)	47 (1.2)	45 (1.3)	31 (1.1)	29 (0.9)	37 (1.1)	35 (1.3)
Hong Kong	60 (0.9)	58 (0.9)	69 (0.8)	67 (0.9)	▲ 50 (1.0)	47 (1.0)	57 (1.0)	54 (0.8)
Iceland	▲ 37 (0.9)	33 (0.8)	▲ 39 (1.1)	35 (1.0)	▲ 28 (0.9)	23 (0.8)	35 (0.9)	32 (1.1)
Iran, Islamic Rep.	29 (0.9)	27 (1.0)	39 (1.4)	37 (1.5)	20 (0.7)	19 (0.7)	▲ 31 (1.0)	27 (1.0)
Ireland	47 (1.0)	49 (1.0)	54 (1.1)	56 (1.0)	41 (1.3)	41 (1.3)	41 (1.0)	41 (0.9)
Japan	64 (0.5)	63 (0.4)	▲ 74 (0.6)	71 (0.6)	52 (0.7)	52 (0.6)	▲ 61 (0.7)	59 (0.6)
Korea	▲ 68 (0.6)	65 (0.5)	▲ 82 (0.6)	79 (0.7)	▲ 54 (0.8)	52 (0.7)	▲ 63 (0.8)	59 (0.7)
New Zealand	40 (0.9)	41 (1.0)	43 (1.2)	41 (1.1)	29 (0.8)	32 (1.0)	39 (0.9)	38 (1.1)
Norway	▲ 37 (0.8)	34 (0.8)	▲ 42 (1.0)	38 (1.2)	25 (0.8)	23 (0.8)	▲ 40 (1.1)	36 (0.9)
Portugal	38 (0.8)	36 (1.1)	47 (1.0)	45 (1.4)	30 (0.7)	29 (0.9)	▲ 39 (1.1)	35 (1.1)
Singapore	62 (1.0)	63 (1.0)	74 (0.9)	76 (0.9)	55 (1.2)	54 (1.1)	52 (1.1)	51 (1.1)
United States	49 (0.6)	49 (0.8)	57 (0.8)	57 (0.9)	37 (0.8)	36 (1.0)	41 (0.8)	40 (1.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):								
Australia	50 (1.1)	49 (1.0)	56 (1.3)	52 (1.3)	38 (1.1)	38 (1.1)	49 (1.2)	47 (1.1)
Austria	51 (1.6)	49 (0.8)	58 (1.3)	58 (1.0)	36 (1.7)	33 (1.0)	▲ 57 (1.9)	53 (1.1)
[1]Latvia (LSS)	44 (1.0)	45 (1.0)	50 (1.1)	50 (1.2)	29 (1.1)	30 (1.1)	48 (1.3)	48 (1.1)
Netherlands	53 (0.7)	51 (0.7)	▲ 59 (0.8)	56 (0.9)	40 (0.6)	38 (0.8)	55 (0.9)	53 (0.9)
Scotland	46 (0.9)	44 (0.8)	48 (1.1)	45 (1.0)	33 (0.9)	32 (0.8)	42 (1.1)	40 (1.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):								
Slovenia	52 (0.7)	50 (0.9)	61 (0.8)	59 (1.1)	37 (0.7)	35 (1.0)	▲ 49 (0.9)	44 (1.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):								
Hungary	49 (1.1)	49 (0.9)	62 (1.3)	62 (1.1)	35 (0.9)	34 (1.0)	49 (1.2)	46 (1.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):								
Thailand	39 (1.1)	41 (1.4)	47 (1.5)	48 (1.6)	31 (1.2)	34 (1.5)	35 (1.0)	36 (1.3)

▲ = Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

---

*Third grade in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 2.5 (Continued)

Average Percent Correct for Boys and Girls by Mathematics Content Areas – Lower Grade (Third Grade*)

Country	Data Representation, Analysis, and Probability		Geometry		Patterns, Relations, and Functions	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Canada	52 (1.1)	52 (1.4)	63 (1.2)	63 (1.1)	49 (1.6)	47 (1.4)
Cyprus	▲ 35 (1.1)	32 (0.9)	42 (1.1)	42 (0.9)	41 (1.3)	40 (1.4)
Czech Republic	52 (1.2)	50 (1.5)	62 (1.0)	61 (1.0)	53 (1.2)	53 (1.4)
[1,2]England	50 (1.3)	50 (1.3)	63 (1.1)	63 (1.0)	▲ 45 (1.3)	40 (1.3)
Greece	35 (1.2)	34 (1.4)	42 (1.3)	41 (1.2)	35 (1.7)	32 (1.4)
Hong Kong	63 (1.3)	63 (1.1)	66 (1.1)	65 (1.1)	58 (1.4)	58 (1.5)
Iceland	▲ 42 (1.6)	36 (1.2)	50 (1.3)	50 (1.7)	35 (1.4)	30 (1.6)
Iran, Islamic Rep.	18 (1.0)	16 (0.9)	34 (1.0)	33 (1.3)	32 (1.5)	28 (1.5)
Ireland	49 (1.3)	50 (1.5)	53 (1.3)	▲ 57 (1.2)	47 (1.4)	49 (1.3)
Japan	69 (0.6)	70 (0.6)	62 (0.7)	62 (0.8)	64 (1.0)	65 (0.9)
Korea	71 (1.1)	68 (1.0)	▲ 68 (0.8)	66 (0.9)	74 (1.0)	72 (1.0)
New Zealand	43 (1.5)	44 (1.5)	56 (1.4)	▲ 60 (1.4)	38 (1.3)	▲ 44 (1.6)
Norway	38 (1.2)	35 (1.3)	44 (1.2)	44 (1.4)	35 (1.7)	33 (1.4)
Portugal	32 (1.1)	30 (1.5)	42 (1.2)	42 (1.5)	37 (1.4)	36 (1.7)
Singapore	67 (1.3)	69 (1.2)	59 (1.0)	61 (0.8)	65 (1.2)	65 (1.3)
United States	56 (0.9)	56 (1.2)	60 (1.0)	62 (1.2)	52 (1.2)	53 (1.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):						
Australia	51 (1.5)	52 (1.4)	64 (1.6)	66 (1.1)	51 (1.3)	48 (1.3)
Austria	50 (2.1)	47 (1.4)	58 (2.2)	56 (1.1)	49 (1.8)	47 (1.8)
[1]Latvia (LSS)	40 (1.5)	39 (1.4)	56 (1.3)	57 (1.3)	52 (1.8)	55 (1.6)
Netherlands	57 (1.1)	55 (1.3)	61 (1.3)	61 (0.9)	50 (1.3)	51 (1.5)
Scotland	50 (1.3)	48 (1.2)	65 (1.1)	65 (1.1)	47 (1.3)	44 (1.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):						
Slovenia	52 (1.3)	52 (1.3)	65 (1.0)	64 (1.1)	54 (1.5)	53 (1.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):						
Hungary	44 (1.3)	46 (1.3)	52 (1.5)	53 (1.1)	56 (1.8)	58 (1.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):						
Thailand	39 (1.6)	43 (2.0)	44 (1.5)	44 (1.7)	39 (1.6)	41 (2.0)

▲ = Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

---

*Third grade in most countries. See Table 2 for information about the grades tested in each country.

[1] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[2] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[3] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Chapter 3

Performance on Items Within Each Mathematics Content Area

This chapter presents five example items within each of the mathematics content areas, including the performance on each of the items for each of the TIMSS countries. The example items in this chapter were chosen to illustrate the different topics covered within each content area as well as the different performance expectations. The items also were chosen to show the range of item formats used within each content area. To provide some sense of what types of items were answered correctly by higher-performing as compared to lower-performing students, the items show a range of difficulty within each content area. Finally, it should be noted that all these items and others are released for use by the public.[1]

The presentation for each of the content areas begins with a brief description of the major topics included in the content area, followed by a series of five tables showing achievement results on example items from that content area. Each table shows the percentages of correct responses on the example item for each of the TIMSS countries at both the third and fourth grades. If the item also was included in the TIMSS mathematics test at the seventh and eighth grades, it is so designated, and the international averages are shown for those grades for purposes of comparison. Each table also presents the example item in its entirety. The correct answer is circled for multiple-choice items and shown in the answer space for short-answer items. For extended-response questions, the answer shown exemplifies the type of student responses that were given full credit. All of the responses shown have been reproduced from students' actual test booklets.

After the tables showing the country-by-country results on each of the items, there is a figure relating achievement on each of the example items to performance on the TIMSS international mathematics scale. This "difficulty map" provides a pictorial representation of achievement on the scale in relation to achievement on the example items for the content area.

What Have Students Learned About Whole Numbers?

The category of whole numbers included understanding place value through the thousands, ordering and comparing numbers, and solving single- as well as multi-step problems involving the operations of addition, subtraction, and multiplication. As shown by the results in Table 3.1, students in most countries demonstrated a basic understanding of the place value of whole numbers (Example Item 1). Students in the fourth grade, in particular, were successful on this item which required students to select the largest number when given four choices, all with four places but differing in the third-, second-, and first-place values (international average of 86% compared to 76% for the lower grade students.) Differences in the ages at which students begin formal schooling and in curricular emphases appear to be reflected in the results. For example, more than 90% of both the third and fourth graders answered this question correctly in Japan and Korea. In Norway, where students begin school at a somewhat older age and thus have had fewer years of formal schooling, this question was answered correctly by 56% of the lower-grade students and 87% of those in the upper grade.

---

[1] The IEA retained about one-third of the TIMSS items as secure for possible future use in measuring international trends in mathematics and science achievement. All remaining items are available for general use.

Table 3.2 presents Example Item 2, asking students to represent an addition fact as a multiplication fact. Students were required to provide a response rather than select an answer in the multiple-choice format. Both 5 x 4 = 20 and 4 x 5 = 20 were considered to be correct responses, as were equivalent written-out statements. As with the results for the item on comparing numbers, students at both grades did well in Hong Kong, Japan, Korea, and Singapore (86% or better). In most countries, however, the results were somewhat lower. As indicated by the international averages of 77% and 63%, respectively, the fourth-grade students tended to perform more than 10 percentage points higher than the third-grade students.

Example Item 3 is a subtraction problem with whole numbers that requires regrouping (see Table 3.3). As noted at the bottom of the table, this item also was part of the mathematics test at seventh and eighth grades. The international averages of 86% at both the seventh and the eighth grades suggest that students in most countries had developed a grasp of how to solve this type of problem prior to the middle school years. In contrast, the results at the third and fourth grades were highly variable. For example, about 90% of the students at both grades answered correctly in Korea and Singapore. Considerable growth between grades was shown in most of the remaining countries. Despite this growth, however, in England and New Zealand fewer than 40% of the fourth graders answered this question correctly.

Example Item 4 asked students to solve an addition number sentence involving whole numbers to different place values (one, two, three, and four places). As shown in Table 3.4, fourth-grade students were more successful than their third-grade counterparts in correctly answering this free-response question (international averages of 63% at fourth grade compared to 44% at third grade). Correct responses included either 700 or its equivalent written out as "seven hundred." In Korea and Singapore, more than 90% of the fourth graders provided the missing value necessary to make the sentence true.

Example Item 5 is the most difficult of the examples shown in the area of whole numbers. Students needed to recognize that compared to 24 multiplied by 18, multiplying 25 by 18 would increase the product by 18. As shown in Table 3.5, on average across countries, fewer than half the fourth graders (45%) and one-third of the third graders (30%) answered this question correctly. Fourth graders in Korea had the best performance (80% correct). Interestingly, increasing the product by 1 (option A) was by far the most popular distracter. Internationally, on average, it was selected by 35% of the fourth graders and 42% of the third graders.

Figure 3.1 presents a pictorial representation of the relationship between performance on the TIMSS international mathematics scale and achievement on the five example items for whole numbers.[2] The international achievement on each example item is indicated both by the average percent correct across all countries at the third and fourth grades and by the international mathematics scale value, or item difficulty level, for each item. Since the scale was developed based on the performance of students at both grades in all countries, the international scale values apply to both grades and to all countries.

For the figure, the item results have been placed on the scale at the point where students at that level were more likely than not (65% probability) to answer the question correctly. For example, students scoring at or above 530 on the scale were likely to provide a correct response to the item asking for the missing value in the addition number sentence (Example Item 4), and those scoring at or above 614 were likely to respond correctly to the problem about the increase in the product when multiplying 18 by 25 rather than by 24 (Example Item 5). Considering that the international average on the scale was 529 at the fourth grade, however, students achieving at about the level of the international average were unlikely to have answered the latter item correctly. These results, however, varied dramatically by country. Fourth-grade students in Singapore, whose mean achievement was 625, had relatively high probabilities of answering all but the most difficult whole number items correctly. Indeed, this is borne out by Singapore's average percent correct of 83% in this content area at the fourth grade.

---

[2] The three-digit item label shown in the lower right corner of the box locating each example item on the item difficulty map refers to the original item identification number used in the student test booklets.

Table 3.1 Whole Numbers

Percent Correct for Example Item 1
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	77 (2.0)	88 (2.0)
Cyprus	65 (3.0)	82 (1.8)
Czech Republic	87 (1.6)	93 (1.3)
[†2] England	69 (3.0)	83 (2.0)
Greece	76 (2.9)	87 (2.6)
Hong Kong	88 (1.5)	95 (1.1)
Iceland	60 (3.7)	80 (3.0)
Iran, Islamic Rep.	48 (3.6)	63 (2.9)
Ireland	81 (2.1)	88 (2.0)
Japan	91 (1.3)	94 (1.0)
Korea	92 (1.6)	97 (1.0)
New Zealand	65 (3.3)	83 (2.6)
Norway	56 (3.0)	87 (1.8)
Portugal	63 (2.8)	80 (1.9)
[†] Scotland	68 (2.3)	85 (1.8)
Singapore	85 (1.3)	91 (1.3)
United States	82 (2.0)	89 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	78 (2.3)	91 (1.5)
Austria	81 (3.3)	95 (1.3)
[1] Latvia (LSS)	77 (2.6)	88 (2.3)
Netherlands	88 (1.9)	93 (1.7)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	86 (2.0)	92 (1.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	85 (2.2)	91 (1.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	91 (1.8)
Kuwait	- -	47 (1.7)
Thailand	76 (3.0)	81 (2.4)
International Average Percent Correct	76 (0.5)	86 (0.4)

Example 1

Choose largest number.

Which of these is the largest number?

A. 2735

B. 2537

C. 2573

[✓ D.] 2753

---

[*] Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.2 Whole Numbers

Percent Correct for Example Item 2
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	58 (2.1)	76 (1.7)
Cyprus	63 (1.9)	83 (1.5)
Czech Republic	63 (2.2)	83 (1.6)
†[2] England	39 (2.0)	53 (1.9)
Greece	58 (2.4)	79 (1.9)
Hong Kong	89 (1.3)	95 (0.9)
Iceland	38 (2.6)	63 (3.0)
Iran, Islamic Rep.	62 (2.0)	73 (1.7)
Ireland	74 (2.2)	86 (1.6)
Japan	86 (1.3)	92 (0.8)
Korea	91 (1.4)	94 (0.9)
New Zealand	45 (2.7)	67 (2.5)
Norway	36 (2.8)	66 (2.5)
Portugal	52 (2.8)	65 (2.3)
† Scotland	51 (2.3)	66 (2.1)
Singapore	87 (1.1)	90 (0.8)
United States	67 (2.3)	84 (1.4)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	57 (2.4)	71 (1.6)
Austria	71 (2.6)	82 (1.7)
[1] Latvia (LSS)	66 (2.5)	81 (2.0)
Netherlands	78 (1.8)	85 (1.5)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix		
Slovenia	69 (2.3)	86 (1.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	61 (2.3)	80 (1.4)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	86 (1.4)
Kuwait	- -	42 (1.9)
Thailand	54 (2.7)	65 (2.2)
International Average Percent Correct	63 (0.5)	77 (0.4)

Example 2

Addition/multiplication fact.

Addition Fact
4 + 4 + 4 + 4 + 4 = 20

Write this addition fact as a multiplication fact.

4 × 5 = 20

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.3 Whole Numbers

Percent Correct for Example Item 3
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	38 (2.9)	61 (3.1)
Cyprus	54 (3.3)	79 (2.4)
Czech Republic	61 (2.6)	83 (1.8)
†[2]England	23 (2.4)	36 (2.5)
Greece	46 (3.1)	82 (2.2)
Hong Kong	78 (2.3)	89 (1.5)
Iceland	15 (2.3)	47 (3.4)
Iran, Islamic Rep.	52 (3.6)	62 (3.2)
Ireland	49 (3.3)	82 (2.5)
Japan	73 (1.9)	89 (1.4)
Korea	88 (2.1)	93 (1.6)
New Zealand	15 (2.3)	30 (3.6)
Norway	9 (1.9)	60 (3.7)
Portugal	60 (3.5)	77 (2.3)
†Scotland	29 (2.2)	55 (2.4)
Singapore	90 (1.0)	91 (1.0)
United States	52 (3.0)	71 (2.2)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	22 (2.5)	47 (2.2)
Austria	76 (2.5)	92 (2.0)
[1]Latvia (LSS)	42 (4.0)	80 (2.8)
Netherlands	46 (3.1)	86 (2.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	62 (3.4)	86 (1.9)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	74 (2.5)	91 (1.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	71 (3.4)
Kuwait	- -	46 (2.4)
Thailand	50 (3.8)	65 (3.0)
International Average Percent Correct	50 (0.6)	71 (0.5)
	Seventh Grade	Eighth Grade
	86 (0.5)	86 (0.4)

Example 3

Subtraction of 4-digit numbers.

Subtract: 6000
−2369

A. 4369

B. 3742

[✓ C.] 3631

D. 3531

Note: Item also tested at seventh and eighth grades.

---

*Third and fourth grades in most countries. See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

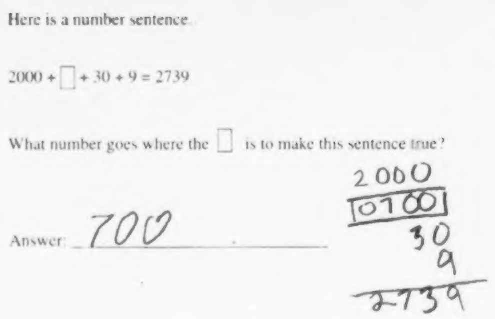
Table 3.4 Whole Numbers

Percent Correct for Example Item 4
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	40 (2.4)	65 (2.2)
Cyprus	40 (2.0)	61 (1.9)
Czech Republic	54 (2.2)	77 (1.7)
†2 England	28 (2.1)	49 (2.1)
Greece	35 (2.4)	52 (2.3)
Hong Kong	75 (1.5)	82 (1.4)
Iceland	17 (2.2)	45 (2.6)
Iran, Islamic Rep.	21 (1.9)	26 (2.3)
Ireland	40 (2.1)	62 (2.1)
Japan	73 (1.3)	86 (1.2)
Korea	81 (1.5)	91 (1.1)
New Zealand	27 (2.2)	49 (2.3)
Norway	18 (1.7)	45 (2.2)
Portugal	45 (2.2)	60 (2.3)
† Scotland	21 (1.6)	47 (1.9)
Singapore	86 (1.1)	92 (0.7)
United States	36 (2.6)	58 (1.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	41 (2.6)	61 (1.9)
Austria	45 (2.6)	61 (2.2)
1 Latvia (LSS)	36 (2.6)	63 (2.5)
Netherlands	53 (3.0)	83 (1.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	60 (2.1)	81 (1.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	50 (2.3)	76 (1.9)
Thailand	42 (3.4)	59 (2.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1 Israel	- -	71 (2.1)
Kuwait	- -	27 (1.5)
Thailand	42 (3.4)	59 (2.5)
International Average Percent Correct	44 (0.5)	63 (0.4)

Example 4

Complete number sentence.



Here is a number sentence.

2000 + ☐ + 30 + 9 = 2739

What number goes where the ☐ is to make this sentence true?

Answer: 700

2000
$\boxed{0700}$
30
9
2739

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

1 National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

2 National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.5 Whole Numbers

Percent Correct for Example Item 5
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	29 (2.4)	41 (3.0)
Cyprus	14 (2.1)	38 (3.1)
Czech Republic	29 (2.7)	50 (2.6)
[†][2]England	27 (2.9)	37 (3.0)
Greece	16 (2.3)	29 (3.1)
Hong Kong	35 (2.6)	63 (2.6)
Iceland	21 (3.2)	33 (3.8)
Iran, Islamic Rep.	16 (2.3)	26 (3.2)
Ireland	29 (2.9)	51 (3.2)
Japan	48 (2.2)	59 (2.6)
Korea	58 (3.1)	80 (1.8)
New Zealand	18 (2.2)	28 (3.0)
Norway	24 (2.4)	38 (2.8)
Portugal	20 (2.6)	38 (3.0)
[†]Scotland	30 (2.6)	37 (2.6)
Singapore	53 (2.4)	73 (1.7)
United States	31 (3.0)	46 (2.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	35 (2.7)	41 (2.5)
Austria	28 (2.9)	58 (3.6)
[1]Latvia (LSS)	30 (3.6)	42 (3.7)
Netherlands	46 (2.4)	60 (3.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	30 (2.4)	51 (3.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	29 (2.2)	52 (2.9)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	47 (3.4)
Kuwait	- -	19 (1.6)
Thailand	24 (3.1)	33 (2.3)
International Average Percent Correct	30 (0.5)	45 (0.6)

Example 5

Increase in product.

25 × 18 is more than 24 × 18. How much more?

A. 1

[✓ B.] 18

C. 24

D. 25

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

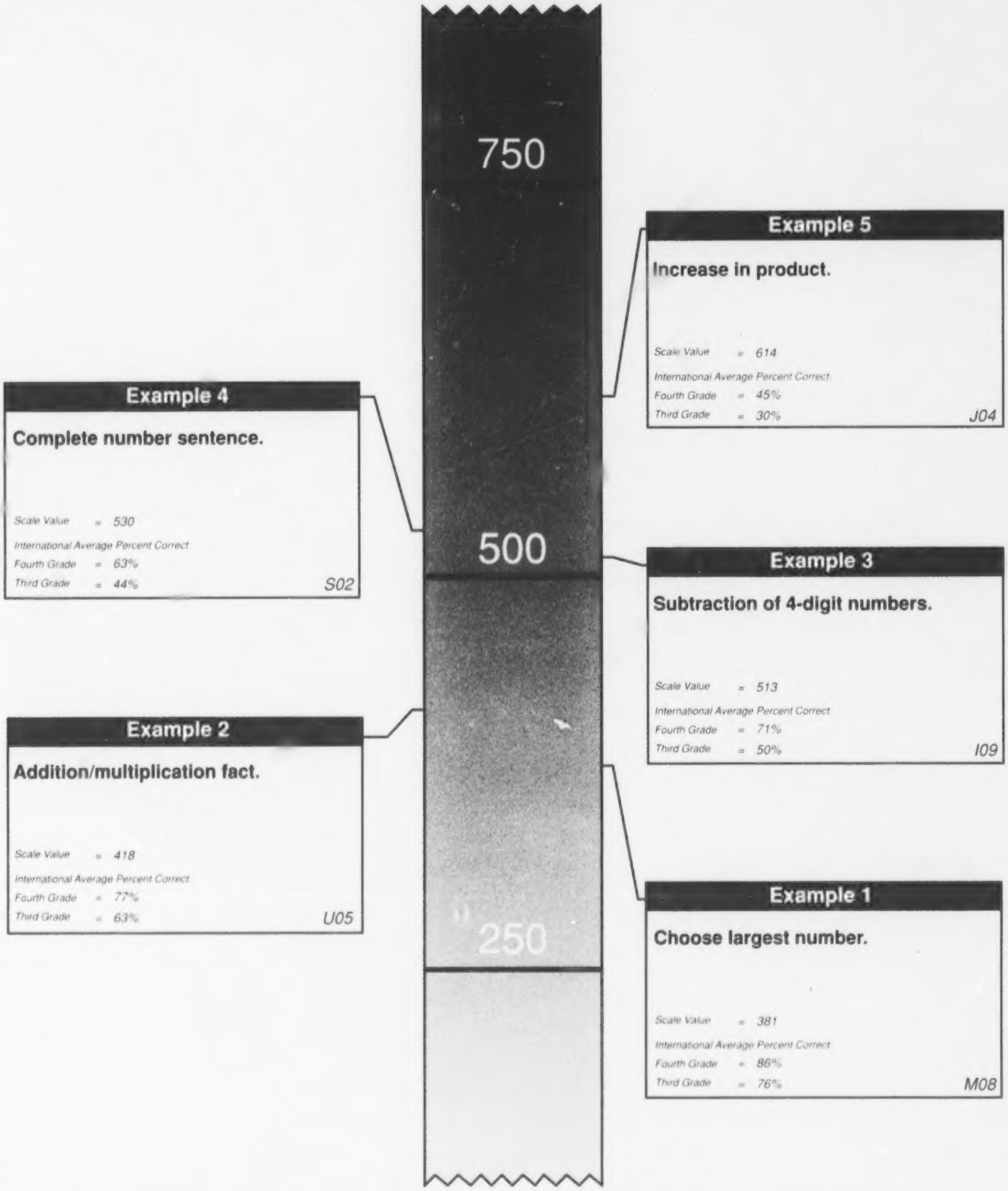
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.1

International Difficulty Map for Whole Numbers Example Items Lower and Upper Grades (Third and Fourth Grades*)



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

NOTE: Each item was placed onto the TIMSS international mathematics scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

WHAT HAVE STUDENTS LEARNED ABOUT FRACTIONS AND PROPORTIONALITY?

Within the content area of fractions and proportionality, students were asked to recognize the pictorial representation of common fractions and decimal fractions as well as the relationships between common and decimal fractions. Several items involved addition and subtraction with fractions and decimals. This content area also included several word problems that could be solved with proportionality and one item involving scale on a map. As indicated in Chapter 2, the items in this content area tended to be more difficult for students than those in the other content areas. For example, the international average across countries in the content area of whole numbers was 66% compared to an average of 48% in the content area of fractions and proportionality.

In the least difficult of the example items, Example Item 6, students were asked to recognize that five-ninths of the figure was shaded. As shown in Table 3.6, about half the students internationally selected the correct response (61%, on average, at the fourth grade and 42% at the third grade). There was a considerable range of performance on this item, however. For example, more than 90% of the fourth-grade students answered this question correctly in Hong Kong, Korea, and Singapore. Five-fourths (option A) was the most commonly selected wrong answer. On average, it was indicated by 28% of the students at the third grade and 23% at the fourth grade. Presumably, these students took the fraction to represent five shaded squares and four unshaded squares.

Example Item 7, a multiple-choice word problem where students could have used proportional reasoning, asked how much sauce could be made from 15 tomatoes if five tomatoes yielded one-half of a liter of sauce. As shown in Table 3.7, approximately one-half of the fourth- and third-grade students internationally answered this question correctly (53% and 42%, respectively.) The results were generally uniform across countries, with about 40% to 60% of the fourth graders providing correct responses in most countries. Somewhat more than 60% of the fourth graders provided correct responses in Hong Kong (73%), Korea (67%), and the Netherlands (67%). Internationally, about one-fourth of both the third and fourth graders selected the answer of three liters (option D), indicating that they grasped the 1 to 3 ratio, but not the fractional unit of measure.

On Example Item 8, requiring students to recognize that 0.2 represented the shaded part of the figure, the international averages for the correct answer were 40% and 33% at the fourth and third grades, respectively. In comparison, internationally, on average, 44% of the fourth-grade students and 43% of the third-grade students selected 2.8 (option A) as their answer. Similar to the misconception about fractional representation shown in Example 6, in this item, many students chose the representation that seemed to suggest two shaded and eight unshaded parts of the figure.

Example Item 9 is a word problem involving subtraction of decimals. As shown in Table 3.9, this problem was extremely difficult for students in many countries (international averages of 26% at fourth grade and 12% at third grade). Korea and Singapore were the only two countries where the majority of the fourth graders provided the completely correct response of 63.2 together with their calculation of 96.4 - 33.2 or its equivalent. (On average across countries, approximately 10% of the fourth-grade students and 8% of the third-grade students received partial credit for providing the correct answer but not showing an acceptable description or calculation.)

In Example Item 10, students were asked to explain their answers using words and pictures (see Table 3.10). For the first part of the question, students needed to express verbally, symbolically, or pictorially that 20 is twice as much as 10, or that 10 is half of 20. As indicated by the sample response, many students drew diagrams or pictographs to explain why Juanita was right. The percentage of correct responses includes both those students who agreed that Juanita was right as well as the very few students (less than 1% in any country) who provided satisfactory explanations but gave neither a "yes" or "no" answer regarding whether Juanita was right. For the second part of this question, students were to express verbally, symbolically, or pictorially that 10 is not half of 30. Students were to answer "no" to the question of whether Amanda was right, but a correct explanation received full credit when neither a "yes" or "no" answer was given. Both parts of this item were very difficult for students. The international averages for Part A were 10% and 21%, respectively, for third and fourth graders. Thirty percent or more of the fourth graders provided fully correct answers in Australia, England, Japan, Korea, the Netherlands, and Singapore. On part B, the international averages were 6% for third-grade students and 15% for fourth-grade students. Thirty percent or more of the fourth graders provided fully correct responses in Japan, Korea, and Singapore.

The item difficulty map for fractions and proportionality is shown in Figure 3.2. The least difficult items involved whole-number proportional reasoning and recognizing the shaded parts of a rectangle representing a fraction. In contrast, the more difficult items involved decimals, or required students to explain their reasoning through words and diagrams.

Table 3.6 Fractions and Proportionality

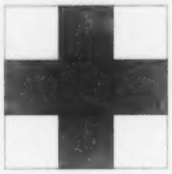
Percent Correct for Example Item 6
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct Third Grade	Percent Correct Fourth Grade
Canada	43 (3.3)	79 (2.6)
Cyprus	67 (2.8)	75 (2.7)
Czech Republic	14 (2.2)	43 (2.9)
†²England	31 (2.8)	48 (3.0)
Greece	27 (2.8)	58 (3.9)
Hong Kong	93 (1.4)	96 (0.9)
Iceland	18 (3.2)	20 (3.1)
Iran, Islamic Rep.	37 (2.7)	68 (2.7)
Ireland	53 (3.2)	79 (2.8)
Japan	78 (2.2)	89 (1.6)
Korea	85 (2.0)	92 (1.4)
New Zealand	36 (3.2)	50 (3.5)
Norway	10 (2.5)	25 (2.8)
Portugal	15 (2.5)	16 (2.3)
†Scotland	40 (3.0)	66 (2.5)
Singapore	92 (1.0)	94 (1.0)
United States	63 (3.2)	80 (1.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	54 (2.5)	71 (2.2)
Austria	13 (2.1)	45 (3.5)
¹Latvia (LSS)	18 (2.6)	48 (3.2)
Netherlands	30 (3.3)	70 (2.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	20 (2.2)	47 (3.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	26 (3.1)	58 (3.2)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
¹Israel	- -	62 (3.4)
Kuwait	- -	21 (1.9)
Thailand	51 (3.7)	75 (3.0)
International Average Percent Correct	42 (0.6)	61 (0.5)

Example 6

Fraction of figure shaded.

Part of the figure is shaded.



What fraction of the figure is shaded?

A. $\frac{5}{4}$

B. $\frac{4}{5}$

C. $\frac{6}{9}$

[✓ D.] $\frac{5}{9}$

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

²National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.7 Fractions and Proportionality

Percent Correct for Example Item 7
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	33 (2.5)	41 (2.3)
Cyprus	46 (2.8)	51 (3.0)
Czech Republic	50 (2.4)	64 (2.9)
†[2]England	39 (2.9)	51 (3.0)
Greece	45 (2.8)	50 (3.2)
Hong Kong	61 (1.8)	73 (2.7)
Iceland	34 (3.7)	44 (3.8)
Iran, Islamic Rep.	35 (3.3)	44 (2.7)
Ireland	41 (2.9)	56 (2.5)
Japan	37 (2.5)	45 (2.4)
Korea	53 (2.7)	67 (2.5)
New Zealand	37 (3.0)	48 (3.6)
Norway	33 (2.6)	51 (3.0)
Portugal	37 (2.7)	42 (3.2)
†Scotland	29 (2.4)	46 (2.5)
Singapore	51 (2.1)	60 (2.2)
United States	37 (3.3)	43 (2.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	49 (2.9)	59 (2.6)
Austria	42 (3.3)	51 (3.0)
[1]Latvia (LSS)	37 (3.5)	53 (3.3)
Netherlands	42 (2.5)	67 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	48 (3.2)	61 (3.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	52 (2.7)	60 (2.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	60 (2.9)
Kuwait	- -	23 (2.3)
Thailand	46 (3.5)	57 (2.7)
International Average Percent Correct	42 (0.6)	53 (0.6)

Example 7

Sauce from 15 tomatoes.

Mario uses 5 tomatoes to make half a liter of tomato sauce. How much sauce can he make from 15 tomatoes?

[✓ A.] A liter and a half

B. Two liters

C. Two liters and a half

D. Three liters

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

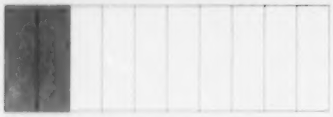
Table 3.8 Fractions and Proportionality

Percent Correct for Example Item 8
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct Third Grade	Percent Correct Fourth Grade
Canada	35 (2.9)	40 (4.4)
Cyprus	16 (2.1)	41 (2.5)
Czech Republic	45 (2.5)	31 (2.1)
†²England	38 (3.2)	34 (2.9)
Greece	36 (2.9)	30 (2.9)
Hong Kong	38 (3.3)	73 (1.8)
Iceland	21 (3.6)	23 (3.5)
Iran, Islamic Rep.	24 (2.6)	35 (3.3)
Ireland	34 (2.9)	48 (3.4)
Japan	67 (2.3)	71 (2.3)
Korea	64 (2.6)	67 (2.7)
New Zealand	26 (2.9)	25 (2.7)
Norway	28 (3.2)	19 (2.4)
Portugal	57 (3.1)	71 (2.7)
†Scotland	34 (2.4)	34 (2.7)
Singapore	23 (1.4)	81 (1.7)
United States	18 (2.5)	32 (2.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	30 (2.4)	40 (2.5)
Austria	28 (4.1)	34 (3.2)
¹Latvia (LSS)	26 (2.9)	30 (3.2)
Netherlands	33 (2.7)	32 (2.7)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	27 (2.5)	29 (3.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	40 (3.3)	31 (2.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
¹Israel	- -	28 (3.2)
Kuwait	- -	32 (2.3)
Thailand	16 (2.3)	35 (3.2)
International Average Percent Correct	33 (0.6)	40 (0.6)

Example 8

Decimal representing shaded part of figure.



Which number represents the shaded part of the figure?

A. 2.8

B. 0.5

[✓ C.] 0.2

D. 0.02

---

*Third and fourth grades in most countries. See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.9 Fractions and Proportionality

Percent Correct for Example Item 9
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	9 (1.2)	25 (2.2)
Cyprus	3 (0.7)	16 (1.4)
Czech Republic	16 (1.6)	38 (1.9)
[†][2] England	9 (1.3)	22 (2.0)
Greece	8 (1.6)	21 (2.0)
Hong Kong	20 (2.6)	32 (2.1)
Iceland	1 (0.6)	6 (1.1)
Iran, Islamic Rep.	1 (0.4)	9 (2.3)
Ireland	12 (1.5)	29 (1.9)
Japan	26 (1.4)	40 (1.9)
Korea	34 (1.9)	53 (2.0)
New Zealand	3 (0.8)	13 (1.9)
Norway	3 (0.8)	19 (1.8)
Portugal	8 (1.3)	15 (1.3)
[†] Scotland	8 (1.2)	27 (2.2)
Singapore	46 (1.7)	61 (1.6)
United States	11 (1.3)	32 (1.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	8 (1.1)	23 (1.3)
Austria	7 (1.5)	31 (2.2)
[1] Latvia (LSS)	8 (1.4)	18 (2.4)
Netherlands	8 (1.0)	28 (2.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	14 (1.6)	33 (2.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	5 (0.9)	13 (1.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	25 (1.9)
Kuwait	- -	5 (0.7)
Thailand	23 (3.7)	32 (2.7)
International Average Percent Correct	12 (0.3)	26 (0.4)

Example 9

Longest box on shelf.

Julie put a box on a shelf that is 96.4 centimeters long. The box is 33.2 centimeters long. What is the longest box she could put on the rest of the shelf? Show all your work.

$$\begin{array}{r} 96.4 \\ -33.2 \\ \hline 63.2 \end{array}$$

Answer: 63.2 c.m. box

---

[*] Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.10 Fractions and Proportionality

Percent Correct for Example Item 10A
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	10 (1.2)	22 (1.7)
Cyprus	5 (1.0)	21 (1.6)
Czech Republic	9 (1.2)	25 (1.5)
[†2]England	17 (1.2)	30 (1.8)
Greece	7 (1.6)	11 (1.4)
Hong Kong	3 (0.6)	11 (2.0)
Iceland	2 (0.7)	5 (1.2)
Iran, Islamic Rep.	3 (0.7)	7 (1.2)
Ireland	12 (1.4)	26 (1.9)
Japan	12 (0.9)	30 (1.6)
Korea	31 (1.7)	43 (2.4)
New Zealand	14 (1.6)	25 (2.5)
Norway	8 (1.4)	24 (2.1)
Portugal	4 (0.8)	9 (1.1)
[†]Scotland	11 (1.3)	26 (1.9)
Singapore	26 (1.9)	41 (1.9)
United States	13 (1.6)	25 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	21 (2.0)	34 (1.6)
Austria	3 (0.9)	13 (1.5)
[1]Latvia (LSS)	3 (0.7)	9 (1.5)
Netherlands	16 (1.7)	38 (2.3)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	9 (1.6)	24 (2.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	- -	- -
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	19 (1.7)
Kuwait	- -	7 (1.0)
Thailand	0 (0.2)	4 (1.3)
International Average Percent Correct	10 (0.3)	21 (0.4)

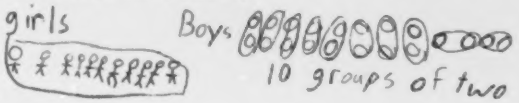
Example 10A

Girl/Boy ratio: Is Juanita right?

There are 10 girls and 20 boys in Juanita's class. Juanita said that there is one girl for every two boys. Her friend Amanda said that means $\frac{1}{2}$ of all the students in the class are girls.

How many students are there in Juanita's class. Answer: 30

Is Juanita right? Answer: yes
Use words or pictures to explain why.



Is Amanda right? Answer: no
Use words and pictures to explain why

because $\frac{1}{2}$ is 15 not 10 girls and it is not 20 boys

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for Hungary on Example 10A.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.10 Fractions and Proportionality (Continued)

Percent Correct for Example Item 10B
Lower and Upper Grades (Third and Fourth Grades[*])

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	3 (0.6)	12 (1.5)
Cyprus	3 (0.8)	12 (1.2)
Czech Republic	5 (1.1)	18 (1.7)
[†2]England	9 (1.0)	20 (1.3)
Greece	1 (0.5)	8 (1.2)
Hong Kong	4 (0.7)	13 (2.0)
Iceland	0 (0.3)	5 (1.1)
Iran, Islamic Rep.	0 (0.3)	1 (0.4)
Ireland	9 (1.5)	25 (1.9)
Japan	10 (1.0)	30 (1.5)
Korea	20 (1.6)	32 (2.0)
New Zealand	7 (1.0)	15 (1.6)
Norway	6 (1.1)	15 (1.7)
Portugal	1 (0.4)	3 (0.6)
[†]Scotland	6 (1.0)	16 (1.7)
Singapore	22 (1.8)	37 (2.0)
United States	6 (1.1)	17 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	11 (1.2)	21 (1.6)
Austria	2 (1.0)	5 (1.0)
[1]Latvia (LSS)	1 (0.4)	6 (1.2)
Netherlands	8 (1.0)	24 (2.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	2 (0.7)	12 (1.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	- -	- -
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[†]Israel	- -	16 (1.7)
Kuwait	- -	4 (0.8)
Thailand	0 (0.2)	4 (1.3)
International Average Percent Correct	6 (0.2)	15 (0.3)

Example 10B

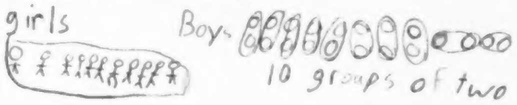
Girl Boy ratio: Is Amanda right?

There are 10 girls and 20 boys in Juanita's class. Juanita said that there is one girl for every two boys. Her friend Amanda said that means $\frac{1}{2}$ of all the students in the class are girls.

How many students are there in Juanita's class. Answer: 30

Is Juanita right? Answer: yes

Use words or pictures to explain why.



Is Amanda right? Answer: no

Use words and pictures to explain why.

because $\frac{1}{2}$ is 15 not 10 girls and it is not 20 boys

---

[*]Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†]Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1]National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2]National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

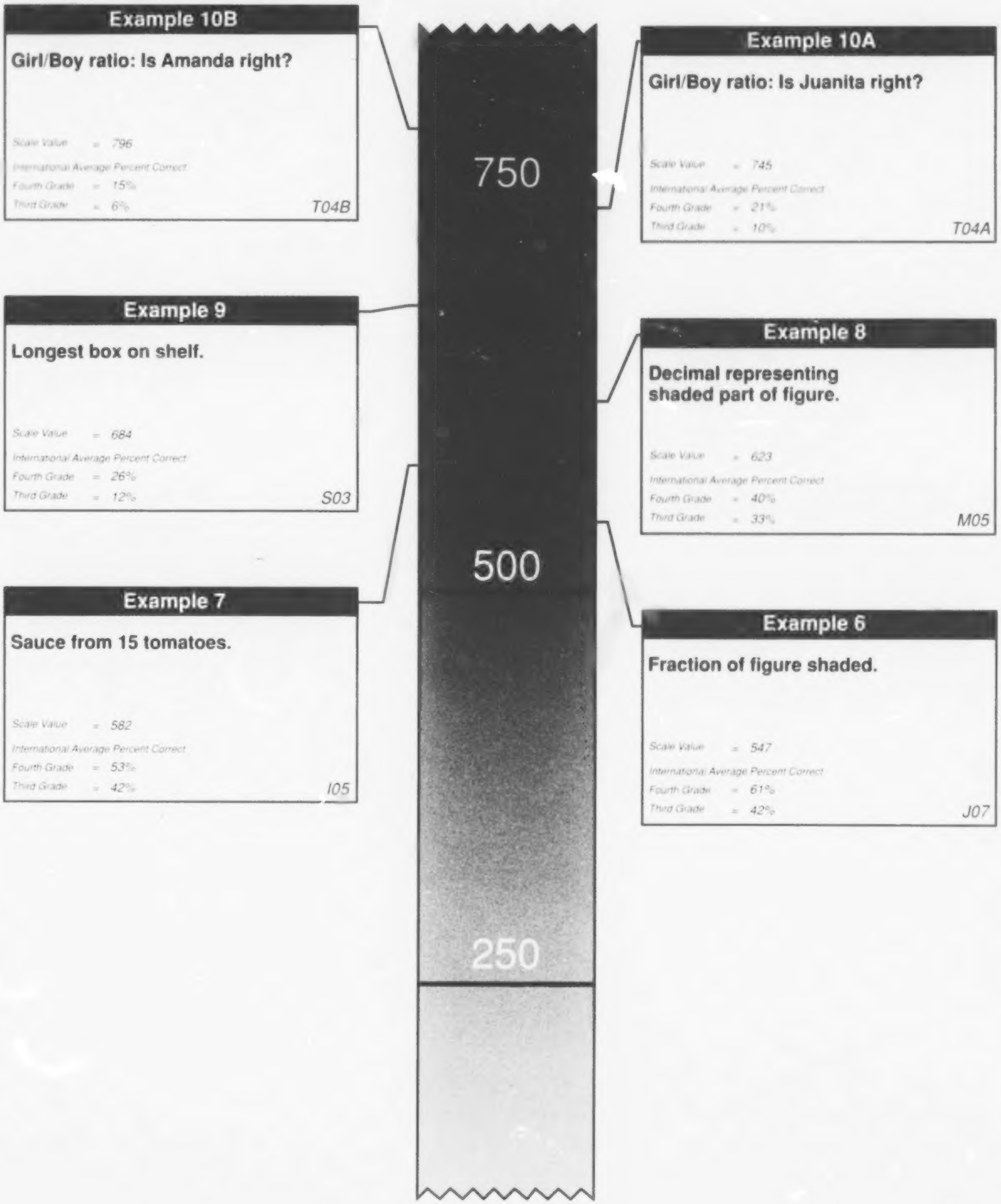
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for Hungary on Example 10B.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.2

International Difficulty Map for Fractions and Proportionality Example Items Lower and Upper Grades (Third and Fourth Grades*)



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

NOTE: Each item was placed onto the TIMSS international mathematics scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

WHAT HAVE STUDENTS LEARNED ABOUT MEASUREMENT, ESTIMATION, AND NUMBER SENSE?

In the content area of measurement, estimation, and number sense, students were asked to demonstrate their understanding of common measures of length, area, volume, time, the calendar, temperature, and weight. Several questions involved rounding and estimation.

As shown in Example Item 11, students were asked to estimate the length of a pencil in centimeters. The international averages were 77% for fourth graders and 69% for third graders (see Table 3.11). More than half the third- and fourth-grade students in each country answered correctly, except the third graders in the United States (46%), which was the only participating country that does not use the metric system. Because understanding the metric system is a goal of mathematics education in the United States, it used the international version of the measurement items related to the metric system rather than changing these items to reflect the more commonly used measures for length and volume.

Students at both grades also did relatively well on Example Item 12, asking them to select the largest mass given choices ranging from 1 milligram to 1 kilogram. The international averages were 72% for fourth-grade students and 61% for third-grade students. As shown in Table 3.12, 90% or more of the fourth graders answered correctly in Japan, Korea, the Netherlands, and Hungary.

When asked to estimate the total weight of 1000 clothespins each weighing 9.2 grams, students in a number of countries had some difficulty. The international averages on Example Item 13 were 55% for fourth graders and 41% for third graders. As shown in Table 3.13, performance was relatively uniform across countries, ranging at the fourth grade from 74% in the Czech Republic to 38% in Iran, with many countries in the 40% to 60% area.

When asked to apply their knowledge of milliliters in Example Item 14, most students did not recognize that liquid in a teaspoon would be measured in this unit (international averages of 38% and 30%). Perhaps surprisingly, about one-fourth of the students internationally did not seem to recognize that milliliters could not be used to measure thickness. Options C and D were equally popular distracters (both were selected by 23% of the students at grade 4). However, more than 70% of the fourth-grade students in Hong Kong (73%) and Japan (75%) answered this question correctly. The increases from third to fourth grade on this item were relatively small in most countries. One exception, however, was Hong Kong (from 41% to 73%).

Example Item 15 is a multi-step problem requiring students to apply their understanding of the perimeter of rectangles. As shown by the results in Table 3.15, this item was very difficult for both third- and fourth-grade students. Both grades performed very similarly, as indicated by the international averages of 23% and 21%. The largest increase and the best performance at the fourth grade was by the students in Singapore, from 19% to 46%.

The international difficulty map for the measurement items is presented in Figure 3.3. It indicates that only the students with higher-than-average mathematics scores internationally were likely to demonstrate that they could go beyond a knowledge of basic weights and lengths to apply measurement skills in various situations.

Table 3.11 Measurement, Estimation, and Number Sense

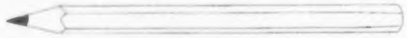
Percent Correct for Example Item 11
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct Third Grade	 Fourth Grade
Canada	66 (3.3)	72 (3.0)
Cyprus	71 (3.0)	86 (1.9)
Czech Republic	79 (2.3)	91 (1.8)
†[2] England	66 (2.8)	68 (3.0)
Greece	58 (2.9)	63 (4.8)
Hong Kong	89 (1.9)	91 (1.8)
Iceland	59 (4.3)	68 (3.7)
Iran, Islamic Rep.	51 (2.7)	66 (2.9)
Ireland	64 (2.7)	79 (2.5)
Japan	84 (1.6)	88 (1.4)
Korea	84 (2.1)	85 (2.0)
New Zealand	64 (3.3)	71 (2.9)
Norway	65 (3.3)	79 (2.4)
Portugal	50 (3.7)	66 (3.3)
† Scotland	65 (2.6)	69 (2.9)
Singapore	88 (1.1)	91 (1.0)
United States	46 (2.1)	55 (2.2)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	68 (2.5)	76 (1.8)
Austria	77 (2.7)	89 (2.0)
[1] Latvia (LSS)	83 (3.1)	85 (2.7)
Netherlands	63 (2.7)	77 (2.6)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	73 (2.4)	84 (2.3)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	61 (2.5)	78 (2.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	66 (2.8)
Kuwait	- -	67 (2.6)
Thailand	72 (3.3)	84 (2.9)
International Average Percent Correct	69 (0.6)	77 (0.5)

Example 11

Estimate pencil length.

About how long is this picture of a pencil?



A. 5 cm

[✓ B.] 10 cm

C. 20 cm

D. 30 cm

(size reduced from original)

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.12 Measurement, Estimation, and Number Sense

Percent Correct for Example Item 12
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	[illegible]	[illegible]
Canada	52 (3.4)	68 (2.2)
Cyprus	15 (1.9)	21 (2.2)
Czech Republic	73 (2.8)	81 (2.3)
[†2]England	54 (2.5)	62 (2.6)
Greece	59 (3.1)	71 (2.9)
Hong Kong	86 (1.8)	89 (1.6)
Iceland	55 (2.9)	71 (3.3)
Iran, Islamic Rep.	47 (3.1)	53 (3.6)
Ireland	44 (2.8)	56 (3.6)
Japan	90 (1.3)	94 (1.0)
Korea	81 (2.1)	90 (1.6)
New Zealand	47 (2.8)	58 (3.3)
Norway	52 (3.5)	74 (3.1)
Portugal	48 (3.5)	79 (2.2)
[†]Scotland	39 (2.7)	55 (2.7)
Singapore	64 (2.3)	76 (1.7)
United States	50 (3.3)	61 (2.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	63 (3.0)	74 (2.2)
Austria	84 (2.2)	89 (2.0)
[1]Latvia (LSS)	64 (3.4)	77 (2.7)
Netherlands	85 (1.6)	92 (1.7)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	75 (2.9)	89 (2.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	76 (2.4)	91 (1.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	50 (3.0)
Kuwait	- -	67 (2.3)
Thailand	65 (2.7)	73 (2.9)
International Average Percent Correct	61 (0.6)	72 (0.5)

Example 12

Choose largest mass.

Which of these is largest?

[✓ A.] 1 kilogram

B. 1 centigram

C. 1 milligram

D. 1 gram

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.13 Measurement, Estimation, and Number Sense

Percent Correct for Example Item 13
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	42 (2.8)	50 (2.3)
Cyprus	32 (2.5)	44 (2.7)
Czech Republic	50 (2.8)	74 (2.5)
[†,2] England	42 (2.8)	47 (2.9)
Greece	27 (3.3)	55 (2.9)
Hong Kong	57 (2.5)	71 (2.6)
Iceland	32 (3.5)	44 (2.9)
Iran, Islamic Rep.	29 (2.5)	38 (2.8)
Ireland	40 (3.2)	52 (2.6)
Japan	- -	- -
Korea	64 (2.5)	67 (2.5)
New Zealand	39 (3.4)	42 (2.8)
Norway	27 (2.9)	49 (3.1)
Portugal	34 (3.4)	43 (2.4)
[†] Scotland	40 (2.8)	50 (2.7)
Singapore	55 (2.0)	59 (2.5)
United States	38 (2.6)	52 (2.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	45 (2.5)	53 (2.3)
Austria	44 (3.6)	65 (2.9)
[1] Latvia (LSS)	34 (3.2)	57 (3.3)
Netherlands	45 (2.8)	71 (3.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	42 (2.5)	71 (2.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	48 (3.1)	71 (2.4)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	62 (2.4)
Kuwait	- -	45 (2.7)
Thailand	45 (3.3)	50 (3.3)
International Average Percent Correct	41 (0.6)	55 (0.5)

Example 13

Best estimate of clothespin mass.

The weight (mass) of a clothespin is 9.2 g. Which of these is the best estimate of the total weight (mass) of 1000 clothespins?

A. 900 g

[✓ B.] 9 000 g

C. 90 000 g

D. 900 000 g

---

[*] Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for Japan on Example 13.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.14 Measurement, Estimation, and Number Sense

Percent Correct for Example Item 14
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	31 (2.4)	31 (2.7)
Cyprus	21 (2.3)	20 (2.9)
Czech Republic	28 (2.3)	32 (2.5)
[†2]England	30 (2.5)	37 (2.8)
Greece	21 (2.6)	27 (3.6)
Hong Kong	41 (2.4)	73 (2.3)
Iceland	29 (3.4)	29 (3.1)
Iran, Islamic Rep.	22 (3.0)	26 (3.1)
Ireland	28 (2.1)	44 (2.8)
Japan	62 (2.0)	75 (1.8)
Korea	25 (2.2)	31 (2.5)
New Zealand	22 (2.5)	35 (3.6)
Norway	21 (2.9)	24 (2.1)
Portugal	31 (2.3)	45 (3.1)
[†]Scotland	27 (2.3)	35 (2.2)
Singapore	39 (2.3)	45 (1.9)
United States	33 (2.8)	38 (2.2)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	31 (3.0)	44 (2.3)
Austria	43 (3.5)	51 (3.0)
[1]Latvia (LSS)	29 (3.5)	42 (3.0)
Netherlands	21 (2.0)	27 (2.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	35 (2.8)	45 (3.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	41 (2.9)	55 (2.6)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	28 (3.1)
Kuwait	- -	15 (1.6)
Thailand	12 (2.1)	22 (2.4)
International Average Percent Correct	30 (0.5)	38 (0.5)

Example 14

Substance measured in milliliters.

Which of these would most likely be measured in milliliters?

[✓ A.] The amount of liquid in a teaspoon

B. The weight (mass) of a pin

C. The amount of gasoline in a tank

D. The thickness of 10 sheets of paper

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.15 Measurement, Estimation, and Number Sense

Percent Correct for Example Item 15
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	19 (1.9)	23 (2.4)
Cyprus	25 (2.5)	28 (2.5)
Czech Republic	15 (1.8)	16 (1.8)
[†][2]England	21 (2.6)	29 (3.2)
Greece	16 (2.2)	16 (2.6)
Hong Kong	20 (1.8)	29 (1.9)
Iceland	21 (2.7)	12 (1.9)
Iran, Islamic Rep.	13 (2.0)	16 (2.2)
Ireland	25 (2.3)	20 (1.9)
Japan	33 (2.2)	32 (2.2)
Korea	37 (2.6)	38 (3.0)
New Zealand	25 (2.4)	23 (2.3)
Norway	18 (2.7)	19 (2.2)
Portugal	19 (2.3)	18 (2.2)
[†]Scotland	26 (2.6)	24 (1.9)
Singapore	19 (1.4)	46 (2.0)
United States	25 (2.7)	23 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	24 (2.6)	23 (2.1)
Austria	25 (4.1)	23 (2.3)
[1]Latvia (LSS)	19 (2.7)	24 (3.1)
Netherlands	31 (2.8)	35 (3.6)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	11 (1.8)	20 (2.3)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	13 (1.8)	15 (2.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	17 (2.5)
Kuwait	- -	22 (1.9)
Thailand	12 (2.1)	15 (2.4)
International Average Percent Correct	21 (0.5)	23 (0.5)

Example 15

Length of rectangle.

A thin wire 20 centimeters long is formed into a rectangle. If the width of this rectangle is 4 centimeters, what is its length?

A. 5 centimeters

[✓ B. 6 centimeters]

C. 12 centimeters

D. 16 centimeters

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

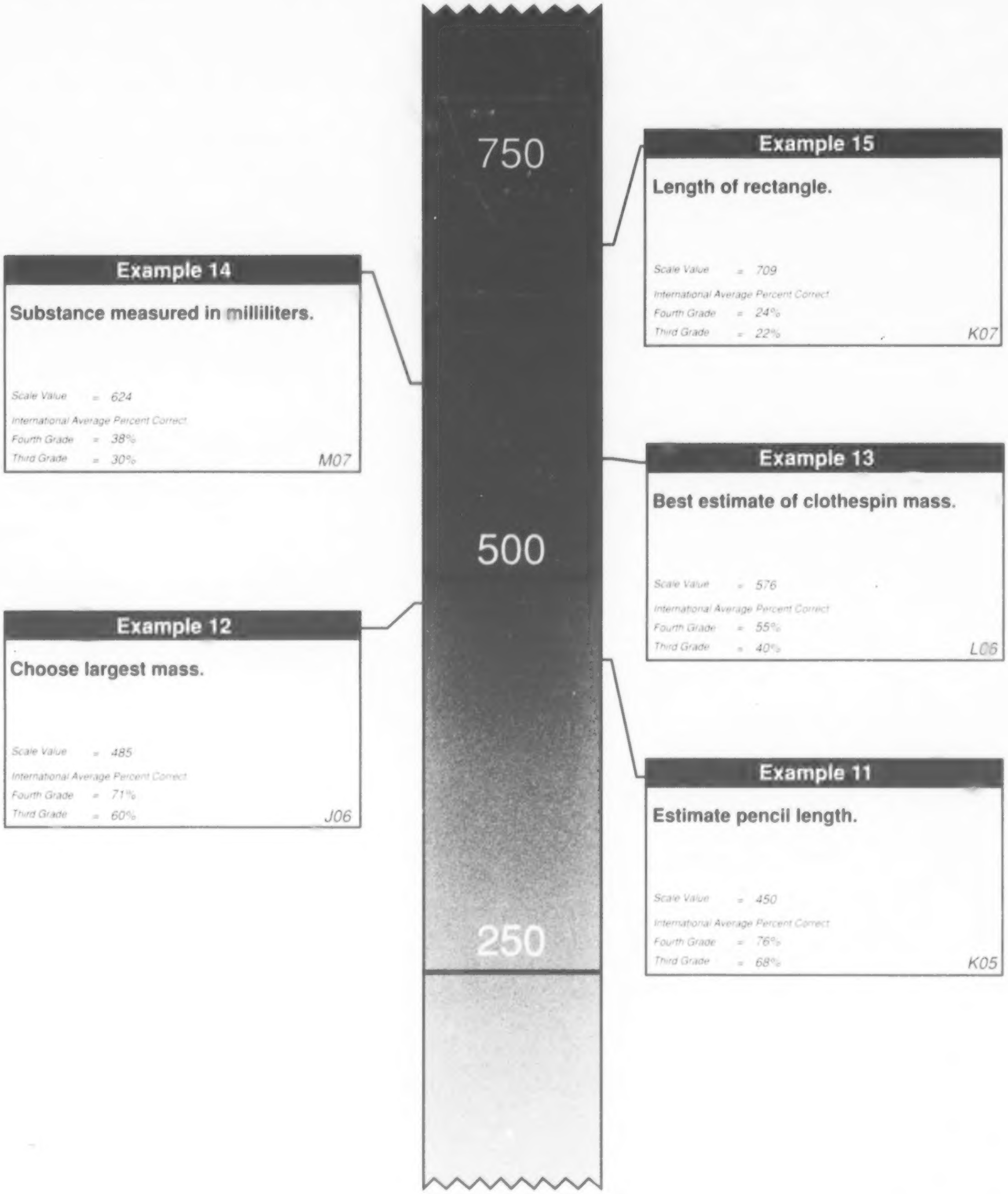
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.3

International Difficulty Map for Measurement, Estimation, and Number Sense Example Items - Lower and Upper Grades (Third and Fourth Grades*)



Example 15

Length of rectangle.

Scale Value = 709
International Average Percent Correct
Fourth Grade = 24%
Third Grade = 22%
K07

Example 14

Substance measured in milliliters.

Scale Value = 624
International Average Percent Correct
Fourth Grade = 38%
Third Grade = 30%
M07

Example 13

Best estimate of clothespin mass.

Scale Value = 576
International Average Percent Correct
Fourth Grade = 55%
Third Grade = 40%
L06

Example 12

Choose largest mass.

Scale Value = 485
International Average Percent Correct
Fourth Grade = 71%
Third Grade = 60%
J06

Example 11

Estimate pencil length.

Scale Value = 450
International Average Percent Correct
Fourth Grade = 76%
Third Grade = 68%
K05

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
NOTE: Each item was placed onto the TIMSS international mathematics scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

WHAT HAVE STUDENTS LEARNED ABOUT DATA REPRESENTATION, ANALYSIS, AND PROBABILITY?

Example Items 16 through 20 illustrate the types of items that were asked about data representation, analysis, and probability. Most of the items in this content area required students to read and use data presented in a variety of charts, tables, and graphs. One task asked them to complete a bar graph from tabular data (Example 20). Two questions dealt with the basic concepts underlying probability (Examples 16 and 18).

Internationally, approximately three-fourths of the fourth graders and two-thirds of the third graders correctly answered Example Item 16 (see Table 3.16). More than 80% of the fourth-grade students in many of the countries appeared to understand that the target with the greatest shaded space had the best chance of being hit.

As shown in Table 3.17, students had little difficulty reading basic information from a bar graph of daily cartons of milk sold at a school, even though some simple interpolation was required to determine that 25 cartons of milk were sold on Monday (see Example Item 17A). The results indicate that this activity was familiar to students in nearly all countries, except Iran and Kuwait. The international averages were 75% and 60%, respectively, at the two grades tested. Students had more difficulty with the second part of this free-response item, when they were asked to provide the number of cartons of milk sold all week and to show their work (see Example Item 17B). International averages on this part of the item decreased to 37% for fourth graders and 19% for third graders. To receive full credit, students needed to give the answer of 125 as well as show their calculation or provide a description of the procedure used. The fourth graders in Singapore had the best performance, providing 80% correct responses.

Example Item 18 assessed the area of probability. In general, about one-half of the fourth-grade students appeared to understand that the probability of picking the one red marble was highest for the bag with the fewest number of marbles. Table 3.18 shows that the international averages were 40% and 51% at the third and fourth grades, respectively. Fifty percent or more of the students at both grades answered this question correctly in Japan, the United States, Australia, and the Netherlands. This item also was part of the TIMSS mathematics test given to seventh- and eighth-grade students. In comparison to performance at the primary grades, the international averages were 74% and 78% at the seventh and eighth grades, respectively. Fourth graders in the Netherlands did particularly well on this item, performing at about the international average for seventh grade.

Performance across countries varied on Example Item 19, which required students to interpret information shown in a pictograph (see Table 3.19). Essentially, this free-response question asked students to determine the key for the graph given the total number of cedar and hemlock trees. That is, students needed to communicate that each tree symbol represented 100 trees. The international averages were 49% and 34% at the fourth and third grades, respectively, indicating growth between the two grades in many countries. Most notably, in the Netherlands performance increased from 30% to 63% correct. Variation in performance ranged from 85% or more of the students in Japan answering correctly at both grades to fewer than 20% answering correctly in Iran and Kuwait.

As shown in Table 3.20, Example Item 20 required students to complete a bar graph of the ages of boys and girls from data presented in a chart. To receive full credit, all four bars needed to be drawn to the appropriate heights. There could be a shading or placement problem in one set of the bars (i.e., for age 9 or age 10). The international averages were 41% at the fourth grade and 24% at the third grade. Seventy percent or more of the fourth graders in Hong Kong (75%), Japan (78%), Korea (83%), and Singapore (74%) received full credit for their bar graphs. The next highest performance was in the United States, where 55% of the fourth graders completed the graph according to the requirements. Internationally, on average, approximately 15% of the students received partial credit for having at least one bar completely correct, or the height of all four bars correct with multiple errors in placement or shading.

The item difficulty map presented in Figure 3.4 indicates that students had some difficulty moving beyond a straightforward reading of data in tables to actually using the data in calculations or to representing the data. Only students performing above the international average were likely to answer such questions correctly (Example "highest probability of hitting a target with the largest shaded area. In contrast, fewer than half answered that the probability of picking the one red marble from a bag of marbles is highest for the bag with the fewest number of marbles.

Table 3.16 Data Representation, Analysis, and Probability

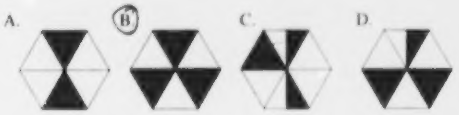
Percent Correct for Example Item 16
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	68 (2.4)	83 (1.[illegible])
Cyprus	55 (3.2)	68 (2.5)
Czech Republic	78 (2.2)	82 (1.9)
†2 England	73 (2.3)	78 (1.9)
Greece	73 (2.8)	84 (2.0)
Hong Kong	75 (1.7)	84 (1.9)
Iceland	62 (3.3)	76 (3.2)
Iran, Islamic Rep.	50 (3.6)	70 (2.7)
Ireland	66 (2.8)	72 (2.5)
Japan	89 (1.2)	89 (1.5)
Korea	81 (2.1)	84 (2.0)
New Zealand	61 (3.2)	74 (2.8)
Norway	70 (3.3)	86 (2.3)
Portugal	41 (3.0)	62 (2.7)
† Scotland	66 (2.6)	73 (2.9)
Singapore	60 (2.2)	70 (1.8)
United States	75 (2.5)	83 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	71 (3.3)	79 (1.9)
Austria	71 (3.3)	81 (2.7)
1 Latvia (LSS)	72 (3.2)	79 (3.0)
Netherlands	80 (2.3)	86 (2.4)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	71 (2.3)	84 (2.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	69 (2.5)	76 (2.3)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1 Israel	- -	85 (2.7)
Kuwait	- -	58 (1.9)
Thailand	69 (3.3)	78 (3.0)
International Average Percent Correct	69 (0.6)	78 (0.5)

Example 16

Chance of hitting shaded region.

Samantha drops a stone onto each of these targets. The stone has the best chance of landing on a shaded space in which target?



---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.17 Data Representation, Analysis, and Probability

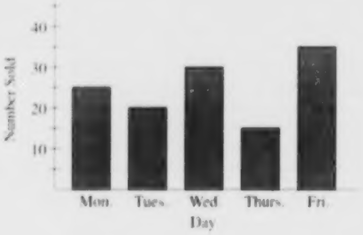
Percent Correct for Example Item 17A
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
Canada	82 (1.3)	93 (0.8)
Cyprus	49 (2.0)	79 (1.3)
Czech Republic	65 (2.0)	85 (1.4)
†2 England	- -	- -
Greece	45 (2.5)	62 (2.7)
Hong Kong	65 (2.0)	74 (1.7)
Iceland	46 (2.5)	77 (2.0)
Iran, Islamic Rep.	7 (1.3)	12 (1.8)
Ireland	62 (2.5)	87 (1.7)
Japan	88 (1.1)	94 (0.7)
Korea	89 (1.3)	96 (0.8)
New Zealand	57 (2.7)	77 (2.2)
Norway	46 (2.3)	79 (1.8)
Portugal	35 (2.5)	57 (2.5)
† Scotland	63 (2.2)	83 (1.5)
Singapore	91 (0.8)	95 (0.5)
United States	75 (1.4)	90 (0.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	71 (2.3)	88 (0.9)
Austria	60 (2.3)	78 (1.8)
1 Latvia (LSS)	47 (2.5)	63 (2.6)
Netherlands	78 (2.0)	94 (1.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	57 (2.4)	73 (2.1)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	49 (2.4)	70 (1.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1 Israel	- -	76 (1.9)
Kuwait	- -	17 (1.5)
Thailand	55 (3.2)	82 (2.1)
International Average Percent Correct	60 (0.4)	75 (0.3)

Example 17A

Bar graph: cartons sold Monday.

The graph shows the number of cartons of milk sold each day of a week at a school.



How many cartons of milk did the school sell on Monday?

Answer: 25

How many cartons of milk did the school sell that week? Show your work.

$$\begin{array}{r} 25 \\ 20 \\ 30 \\ 15 \\ +35 \\ \hline 125 \end{array}$$

Answer: 125

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for England on Example 17.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

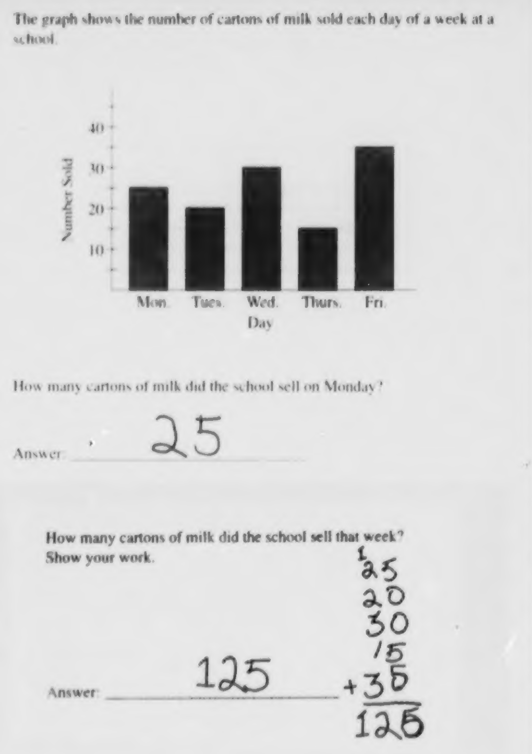
Table 3.17 Data Representation, Analysis, and Probability (Continued)

Percent Correct for Example Item 17B
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	23 (2.2)	46 (2.8)
Cyprus	4 (0.8)	18 (1.7)
Czech Republic	26 (1.8)	51 (2.0)
[1][2]England	- -	- -
Greece	14 (1.5)	33 (2.2)
Hong Kong	23 (2.0)	38 (2.1)
Iceland	4 (1.1)	20 (1.8)
Iran, Islamic Rep.	1 (0.4)	4 (1.0)
Ireland	15 (1.8)	48 (2.2)
Japan	23 (1.7)	32 (1.9)
Korea	54 (2.0)	73 (2.0)
New Zealand	9 (1.3)	30 (2.6)
Norway	5 (1.0)	28 (1.9)
Portugal	11 (1.6)	26 (2.0)
[†]Scotland	19 (1.7)	43 (2.3)
Singapore	65 (1.6)	80 (1.3)
United States	28 (2.0)	57 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	13 (1.5)	34 (1.8)
Austria	15 (1.9)	38 (3.0)
[1]Latvia (LSS)	18 (2.1)	33 (2.7)
Netherlands	25 (1.8)	56 (2.5)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	30 (2.4)	48 (2.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	10 (1.3)	28 (1.9)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	40 (2.6)
Kuwait	- -	3 (0.8)
Thailand	8 (1.7)	23 (2.2)
International Average Percent Correct	19 (0.3)	37 (0.4)

Example 17B

Bar graph: cartons sold for week.



The graph shows the number of cartons of milk sold each day of a week at a school.

Number Sold
40
30
20
10
Mon.
Tues.
Wed.
Thurs.
Fri.
Day

How many cartons of milk did the school sell on Monday?

Answer: 25

How many cartons of milk did the school sell that week? Show your work.

$$\begin{array}{r} {}^{1} \\ 25 \\ 20 \\ 30 \\ 15 \\ +35 \\ \hline 125 \end{array}$$

Answer: 125

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for England on Example 17.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.18 Data Representation, Analysis, and Probability

Percent Correct for Example Item 18
Lower and Upper Grades (Third and Fourth Grades*)

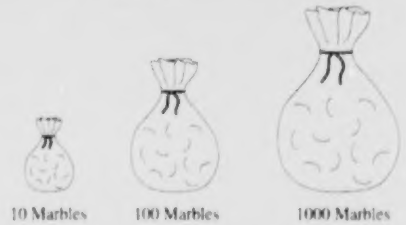
Country	Percent Correct Third Grade	 Fourth Grade
Canada	49 (3.0)	63 (3.0)
Cyprus	20 (2.5)	32 (2.8)
Czech Republic	42 (2.5)	56 (2.5)
[1,2] England	41 (2.5)	55 (2.9)
Greece	21 (2.5)	30 (3.0)
Hong Kong	45 (2.0)	69 (3.1)
Iceland	36 (4.2)	47 (3.7)
Iran, Islamic Rep.	16 (2.2)	17 (2.5)
Ireland	46 (2.6)	52 (2.6)
Japan	64 (1.9)	70 (2.4)
Korea	36 (2.4)	39 (3.1)
New Zealand	40 (2.6)	55 (3.6)
Norway	41 (4.1)	58 (3.1)
Portugal	26 (2.5)	30 (2.4)
[1] Scotland	42 (2.5)	55 (2.5)
Singapore	46 (2.2)	61 (1.9)
United States	54 (2.7)	68 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	52 (4.1)	59 (2.3)
Austria	38 (3.8)	54 (3.6)
[1] Latvia (LSS)	23 (2.6)	42 (3.5)
Netherlands	56 (2.6)	74 (2.6)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	44 (3.3)	49 (2.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	46 (3.0)	61 (3.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	51 (2.7)
Kuwait	- -	31 (2.1)
Thailand	30 (3.3)	39 (2.8)
International Average Percent Correct	40 (0.6)	51 (0.6)
	Seventh Grade	**Eighth Grade**
	74 (0.5)	78 (0.4)

Note: Item also tested at seventh and eighth grades.

Example 18

Chance of picking red marble.

There is only one red marble in each of these bags.



Without looking in the bags, you are to pick a marble out of one of the bags. Which bag would give you the greatest chance of picking the red marble?

[✓ A.] The bag with 10 marbles

B. The bag with 100 marbles

C. The bag with 1000 marbles

D. All bags would give the same chance.

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[1] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[2] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[3] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.19 Data Representation, Analysis, and Probability

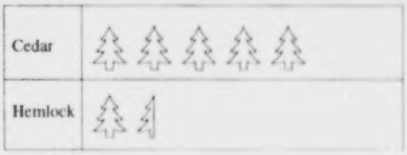
Percent Correct for Example Item 19
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
Canada	32 (2.9)	49 (4.9)
Cyprus	40 (3.0)	50 (2.9)
Czech Republic	29 (2.7)	51 (3.4)
[†2]England	31 (2.6)	49 (2.6)
Greece	21 (4.2)	25 (2.6)
Hong Kong	59 (2.7)	83 (2.1)
Iceland	44 (4.1)	54 (3.9)
Iran, Islamic Rep.	9 (1.7)	16 (2.3)
Ireland	32 (3.1)	62 (3.1)
Japan	85 (1.6)	90 (1.5)
Korea	40 (2.4)	63 (2.7)
New Zealand	26 (3.3)	45 (3.3)
Norway	20 (3.1)	40 (3.2)
Portugal	21 (3.0)	22 (2.7)
[†]Scotland	35 (2.8)	56 (2.8)
Singapore	63 (2.1)	75 (1.8)
United States	40 (2.4)	68 (2.2)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	35 (4.2)	51 (2.6)
Austria	31 (3.1)	45 (3.5)
[1]Latvia (LSS)	20 (2.9)	31 (3.8)
Netherlands	30 (2.6)	63 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	33 (2.7)	44 (3.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	24 (2.3)	44 (2.4)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[†]Israel	- -	51 (3.1)
Kuwait	- -	7 (1.4)
Thailand	27 (3.5)	48 (3.6)
International Average Percent Correct	34 (0.6)	49 (0.6)

Example 19

Pictograph of trees

The graph shows 500 cedar trees and 150 hemlock trees.



How many trees does each 🌲 represent?

Answer: 100

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.20 Data Representation, Analysis, and Probability

Percent Correct for Example Item 20
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	24 (1.7)	46 (2.6)
Cyprus	10 (1.1)	30 (2.3)
Czech Republic	17 (1.7)	33 (2.1)
[†2] England	28 (2.0)	49 (2.2)
Greece	13 (1.7)	28 (2.0)
Hong Kong	59 (2.1)	75 (1.9)
Iceland	15 (2.1)	36 (2.9)
Iran, Islamic Rep.	0 (0.2)	1 (0.5)
Ireland	19 (2.1)	34 (2.0)
Japan	55 (1.5)	78 (1.3)
Korea	69 (2.0)	83 (1.5)
New Zealand	26 (2.1)	48 (2.8)
Norway	8 (1.3)	26 (2.5)
Portugal	5 (1.0)	13 (1.3)
[†] Scotland	24 (1.7)	45 (2.0)
Singapore	48 (2.1)	74 (1.6)
United States	31 (2.3)	55 (1.7)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	29 (2.1)	50 (1.8)
Austria	16 (2.1)	39 (3.2)
[1] Latvia (LSS)	16 (1.8)	31 (3.1)
Netherlands	18 (1.6)	42 (2.8)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	18 (1.8)	32 (2.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	14 (1.5)	31 (2.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	37 (2.4)
Kuwait	- -	8 (0.9)
Thailand	20 (3.1)	38 (3.2)
International Average Percent Correct	24 (0.4)	41 (0.4)

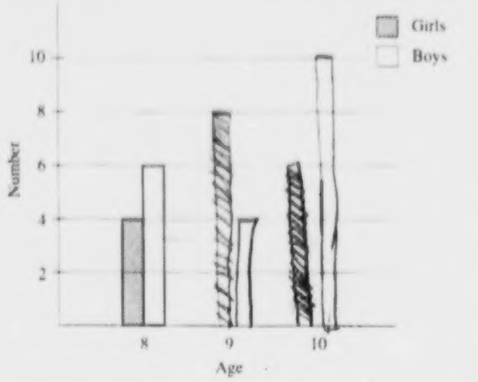
Example 20

Bar graphs of boys and girls.

This table shows the ages of the girls and boys in a club.

Age	Number of Girls	Number of Boys
8	4	6
9	8	4
10	6	10

Use the information in the table to complete the graph for ages 9 and 10.



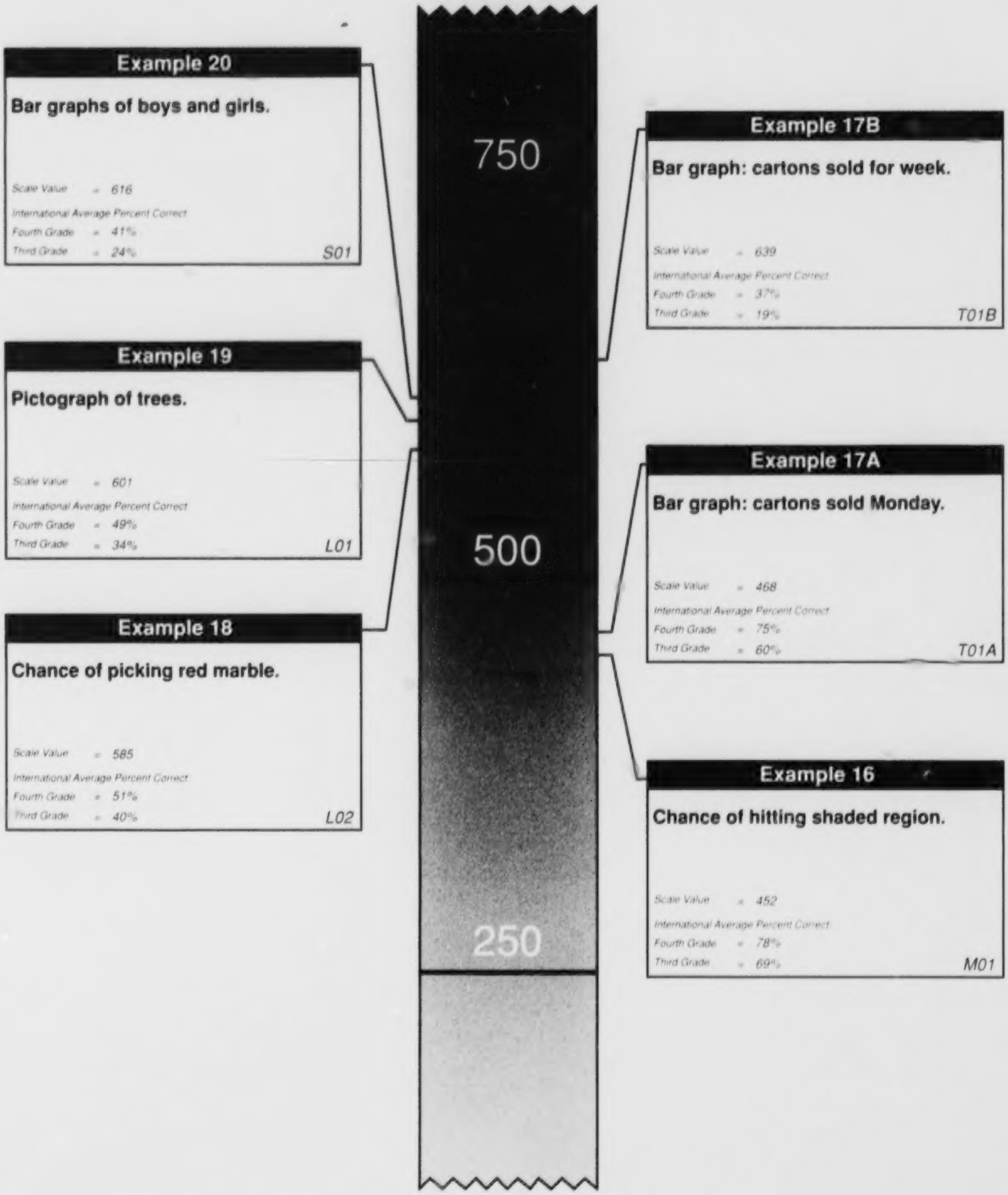
---

[*] Third and fourth grades in most countries. See Table 2 for information about the grades tested in each country.
[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.4

International Difficulty Map for Data Representation, Analysis, and Probability Example Items – Lower and Upper Grades (Third and Fourth Grades*)



Example 20

Bar graphs of boys and girls.

Scale Value = 616
International Average Percent Correct
Fourth Grade = 41%
Third Grade = 24%
S01

Example 19

Pictograph of trees.

Scale Value = 601
International Average Percent Correct
Fourth Grade = 49%
Third Grade = 34%
L01

Example 18

Chance of picking red marble.

Scale Value = 585
International Average Percent Correct
Fourth Grade = 51%
Third Grade = 40%
L02

Example 17B

Bar graph: cartons sold for week.

Scale Value = 639
International Average Percent Correct
Fourth Grade = 37%
Third Grade = 19%
T01B

Example 17A

Bar graph: cartons sold Monday.

Scale Value = 468
International Average Percent Correct
Fourth Grade = 75%
Third Grade = 60%
T01A

Example 16

Chance of hitting shaded region.

Scale Value = 452
International Average Percent Correct
Fourth Grade = 78%
Third Grade = 69%
M01

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
NOTE: Each item was placed onto the TIMSS international mathematics scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

WHAT HAVE STUDENTS LEARNED ABOUT GEOMETRY?

The 14 items in the area of geometry represented a variety of content topics. For example, students were asked to recognize basic two-dimensional and three-dimensional forms, know basic terms and properties, use visualization to identify equivalence between turned figures, and read coordinate points on a grid.

The data in Table 3.21 reveal that students at both grades had a high degree of success in determining that the plane was located at 2, D on the game board grid (Example Item 21). The international averages of correct responses were 88% at the fourth grade and 80% at the third grade. More than 90% of the fourth-grade students responded correctly in many countries.

Example Item 22 asked students to identify which of four rectangles was not divided into four equal parts. Third graders had more difficulty than fourth graders (international average of 60% compared to 73% for fourth graders). However, the data in Table 3.22 reveal that performance was highly variable. For example, more than 80% of the students at both grades answered this item correctly in Korea and Singapore. In comparison, fewer than 40% did so in Iran and Kuwait, indicating that such visualization tasks are more prevalent in the primary grade curriculum in some Asian countries than they are in some Middle Eastern countries.

As shown in Table 3.23, Example Item 23 required students to draw what a cut-out shape would look like when it is opened up and flattened out. Students could depict either the cut-out shape or the remaining piece of paper with the shape cut out, but the majority tended to the former. The international averages were 59% correct at the fourth grade and 45% at the third grade. In the four Asian countries, 80% or more of the fourth graders responded correctly, followed by 76% responding correctly in both England and Scotland.

In Example Item 24, students needed to use their counting and map-reading skills to determine the point where a school was located. As shown in Table 3.24, approximately half were successful internationally (54% of the fourth graders and 43% of the third graders). Most countries showed an increase in performance between the grades that corresponded to the international results.

Table 3.25 presents the results for Example Item 25, which was based on a figure of a solid cube. Students were asked about the number of edges on the cube. Generally, students at both grades found this a difficult task (international averages of 42% at the fourth grade and 35% at the third grade). Approximately one-third of the students at both grades selected 8 (option B) as their answer. At both grades, however, there was quite a range in performance. For example, at the fourth grade, performance ranged from 17% in Iran and Kuwait to 72% in Hong Kong. Also, the degree of growth between the two grades varied substantially from country to country.

The item difficulty map for the geometry items is presented in Figure 3.5. It indicates that third-grade students in particular have difficulty with a variety of visualization tasks. Most students at both grades could read the coordinates on a simple grid.

Table 3.21 Geometry

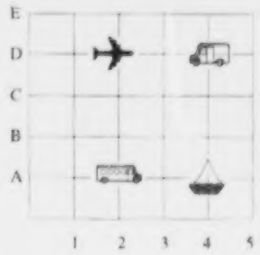
Percent Correct for Example Item 21
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	85 (2.3)	93 (2.0)
Cyprus	67 (2.7)	83 (1.9)
Czech Republic	89 (1.8)	96 (1.2)
†2 England	89 (1.6)	94 (1.3)
Greece	70 (2.9)	86 (2.0)
Hong Kong	81 (2.3)	93 (1.4)
Iceland	78 (3.0)	93 (1.9)
Iran, Islamic Rep.	51 (2.5)	70 (2.6)
Ireland	80 (2.4)	92 (1.7)
Japan	- -	- -
Korea	89 (1.8)	91 (1.6)
New Zealand	85 (2.6)	93 (1.6)
Norway	78 (2.8)	88 (2.1)
Portugal	66 (2.8)	69 (2.3)
† Scotland	89 (1.8)	95 (1.2)
Singapore	84 (1.3)	92 (1.2)
United States	93 (1.2)	97 (0.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	86 (2.6)	94 (1.0)
Austria	83 (2.5)	90 (2.2)
1 Latvia (LSS)	70 (2.9)	85 (2.1)
Netherlands	92 (1.7)	97 (1.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	85 (2.0)	93 (1.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	78 (2.4)	88 (1.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1 Israel	- -	80 (2.7)
Kuwait	- -	61 (2.3)
Thailand	69 (3.1)	80 (3.1)
International Average Percent Correct	80 (0.5)	88 (0.4)

Example 21

Objects on game board grid.

This is a game board.



Which object is located at (2,D)?

[✓ A.] The plane

B. The truck

C. The bus

D. The boat

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for Japan on Example 21.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.22 Geometry

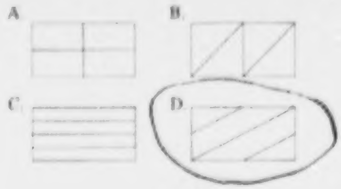
Percent Correct for Example Item 22
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	69 (2.5)	78 (3.7)
Cyprus	41 (2.9)	66 (2.5)
Czech Republic	63 (3.1)	82 (2.3)
[†][2] England	64 (2.5)	75 (2.1)
Greece	29 (3.0)	52 (3.7)
Hong Kong	62 (2.8)	78 (3.1)
Iceland	52 (3.7)	75 (3.6)
Iran, Islamic Rep.	33 (2.7)	38 (2.4)
Ireland	56 (2.6)	83 (2.2)
Japan	72 (2.1)	86 (1.4)
Korea	83 (1.9)	90 (2.0)
New Zealand	57 (3.4)	69 (3.2)
Norway	38 (3.0)	63 (2.8)
Portugal	37 (2.6)	49 (2.8)
[†] Scotland	71 (2.7)	77 (2.0)
Singapore	83 (1.5)	85 (1.4)
United States	68 (2.2)	83 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	70 (2.8)	84 (1.2)
Austria	61 (3.6)	83 (2.6)
[†] Latvia (LSS)	58 (3.7)	75 (3.1)
Netherlands	78 (2.5)	89 (2.0)
Countries Not Meeting Age Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	72 (2.7)	78 (2.4)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	55 (2.1)	78 (2.2)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	72 (2.8)
Kuwait	- -	35 (2.3)
Thailand	54 (3.5)	71 (2.1)
International Average Percent Correct	60 (0.6)	73 (0.5)

Example 22

Rectangle divided into four parts.

Which rectangle is NOT divided into 4 equal parts?



---

*Third and fourth grades in most countries. See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (--) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.23 Geometry

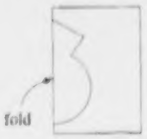
Percent Correct for Example Item 23
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	53 (2.8)	68 (1.8)
Cyprus	11 (1.4)	35 (2.2)
Czech Republic	50 (2.2)	63 (1.7)
†2 England	61 (1.8)	76 (1.8)
Greece	18 (2.1)	28 (2.7)
Hong Kong	71 (2.2)	81 (1.6)
Iceland	39 (2.1)	57 (2.7)
Iran, Islamic Rep.	10 (1.3)	15 (1.4)
Ireland	42 (1.9)	57 (2.3)
Japan	75 (1.7)	88 (1.0)
Korea	73 (1.9)	84 (1.4)
New Zealand	48 (2.7)	64 (2.3)
Norway	22 (2.2)	43 (2.7)
Portugal	16 (1.6)	26 (2.2)
† Scotland	60 (2.0)	76 (1.8)
Singapore	54 (1.8)	87 (0.9)
United States	45 (1.7)	66 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	61 (2.6)	72 (1.5)
Austria	50 (2.9)	66 (2.2)
1 Latvia (LSS)	47 (2.9)	60 (2.9)
Netherlands	55 (2.1)	71 (2.5)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	56 (2.0)	68 (2.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	36 (2.0)	62 (2.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
† Israel	- -	55 (2.4)
Kuwait	- -	7 (1.0)
Thailand	31 (3.6)	46 (3.3)
International Average Percent Correct	45 (0.5)	59 (0.4)

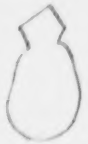
Example 23

Cut-out shape.

Craig folded a piece of paper in half and cut out a shape.



Draw a picture to show what the cut-out shape will look like when it is opened up and flattened out.



---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

BEST COPY AVAILABLE

Table 3.24 Geometry

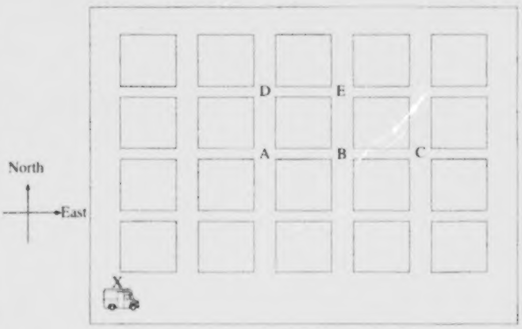
Percent Correct for Example Item 24
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	[illegible]	[illegible]
Canada	49 (3.3)	59 (2.6)
Cyprus	29 (2.6)	41 (3.1)
Czech Republic	50 (2.7)	68 (2.5)
†²England	46 (3.0)	64 (3.0)
Greece	26 (2.8)	36 (3.3)
Hong Kong	55 (2.7)	66 (2.3)
Iceland	41 (3.7)	48 (3.3)
Iran, Islamic Rep.	18 (2.7)	18 (1.9)
Ireland	43 (3.0)	54 (2.8)
Japan	62 (2.1)	77 (2.0)
Korea	59 (2.9)	68 (2.7)
New Zealand	47 (3.7)	52 (3.5)
Norway	41 (3.7)	60 (3.2)
Portugal	25 (2.9)	34 (2.7)
†Scotland	54 (2.8)	61 (2.5)
Singapore	28 (1.6)	48 (2.1)
United States	52 (2.9)	62 (2.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	47 (2.7)	59 (2.1)
Austria	58 (3.5)	70 (3.5)
¹Latvia (LSS)	46 (3.8)	63 (3.4)
Netherlands	44 (2.7)	63 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	50 (3.2)	63 (2.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	48 (3.3)	59 (3.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
¹Israel	- -	54 (3.2)
Kuwait	- -	24 (2.1)
Thailand	20 (3.3)	24 (4.2)
International Average Percent Correct	43 (0.6)	54 (0.6)

Example 24

Map of city blocks.

This map shows city blocks with a delivery truck at one corner.



The driver of the delivery truck starts at corner X. He goes 3 blocks east and 2 blocks north to get to the school. On what corner is the school located?

A. A

[✓ B.] B

C. C

D. D

E. E

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

²National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.25 Geometry

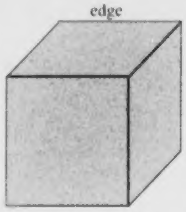
Percent Correct for Example Item 25
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	50 (3.1)	59 (5.3)
Cyprus	21 (2.1)	25 (2.4)
Czech Republic	44 (3.0)	47 (3.0)
[†2]England	30 (2.7)	39 (2.6)
Greece	18 (2.4)	33 (3.0)
Hong Kong	53 (3.2)	72 (2.0)
Iceland	19 (3.0)	25 (4.1)
Iran, Islamic Rep.	11 (1.6)	17 (2.5)
Ireland	35 (3.3)	43 (3.0)
Japan	53 (2.3)	59 (2.8)
Korea	48 (2.7)	31 (2.5)
New Zealand	32 (3.1)	32 (3.3)
Norway	- -	- -
Portugal	35 (3.0)	62 (2.6)
[†]Scotland	39 (2.4)	44 (2.8)
Singapore	33 (1.9)	44 (2.2)
United States	24 (2.9)	35 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	44 (3.3)	53 (2.6)
Austria	33 (4.0)	50 (3.4)
[1]Latvia (LSS)	29 (3.2)	32 (2.8)
Netherlands	43 (2.8)	55 (2.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	60 (2.8)	60 (2.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	32 (2.7)	42 (2.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	32 (3.0)
Kuwait	- -	17 (1.8)
Thailand	14 (3.2)	32 (3.2)
International Average Percent Correct	35 (0.6)	42 (0.6)

Example 25

Edges of cube.

This picture shows a cube with one edge marked. How many edges does the cube have altogether?



A. 6

B. 8

[✓ C.] 12

D. 24

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

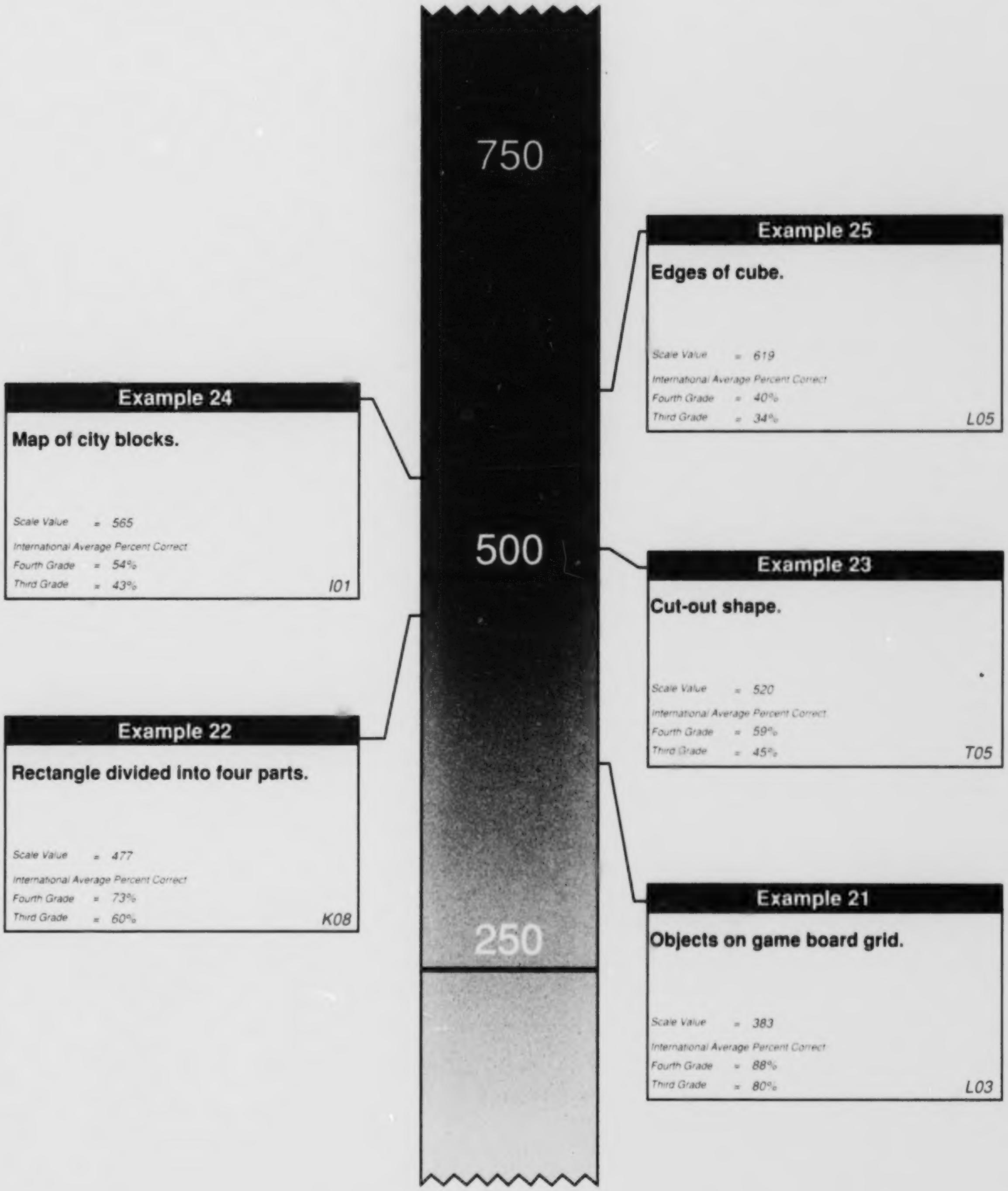
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for Norway on Example 25.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.5

International Difficulty Map for Geometry Example Items Lower and Upper Grades (Third and Fourth Grades*)



Example 25

Edges of cube.

Scale Value = 619
International Average Percent Correct
Fourth Grade = 40%
Third Grade = 34%
L05

Example 24

Map of city blocks.

Scale Value = 565
International Average Percent Correct
Fourth Grade = 54%
Third Grade = 43%
I01

Example 23

Cut-out shape.

Scale Value = 520
International Average Percent Correct
Fourth Grade = 59%
Third Grade = 45%
T05

Example 22

Rectangle divided into four parts.

Scale Value = 477
International Average Percent Correct
Fourth Grade = 73%
Third Grade = 60%
K08

Example 21

Objects on game board grid.

Scale Value = 383
International Average Percent Correct
Fourth Grade = 88%
Third Grade = 80%
L03

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

NOTE: Each item was placed onto the TIMSS international mathematics scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

WHAT HAVE STUDENTS LEARNED ABOUT PATTERNS, RELATIONS, AND FUNCTIONS?

The 10 items in this content area involved patterns of numbers and shapes, representations of simple numerical situations, and relationships between sequences of numbers. In Example Item 26, students were asked to identify the same pattern as portrayed by two different sets of shapes. The international averages show substantial growth from the third grade (61%) to the fourth grade (72%), and indicate that by the seventh and eighth grades most students (about 90%) can demonstrate this basic skill (see Table 3.26). The increase between the third and fourth grades was particularly notable in Greece, from 29% to 51%.

Example Item 27 required students to recognize that 4 x 4 was less than 17, and that, thus, four would make the number sentence true. Internationally, growth between grades also was substantial on this item, from 55% to 70% (see Table 3.27). Third-grade students in Korea did particularly well on this item – 88% correct. The next highest performance at the third grade was in Japan (79%), Slovenia (75%), Singapore (73%), and Latvia (72%). Such results indicate that representation of numerical situations is introduced quite early in the curriculum of some countries.

Example Item 28 asked students to work out the relationships among several logic statements in order to determine that Henry is older than Peter. As shown in Table 3.28, results also were relatively stable across countries. However, the international averages of 63% at the fourth grade and 55% at the third grade indicate less than the average increase of 13% between grades shown in Chapter 2.

To receive full credit on Example Item 29, students needed to demonstrate that they understood what to do to get the next number in a subtraction series. For example, they could explain that the numbers were decreasing by 4, provide the next number or numbers in the series, or give any other type of answer that communicated information about the operation involved. As shown in Table 3.29, the international averages were 57% at the fourth grade and 41% at the third grade. There was a great deal of variation across countries, however. For example, at the fourth grade 79% of the students answered correctly in Singapore and Hungary compared to 12% in Kuwait.

Example Item 30 required students to identify the relationship between two columns of numbers. The results in Table 3.30 reveal that, on average across countries, only 39% of the fourth graders and 27% of the third graders determined that you needed to divide the number in Column A by 5 to obtain the number next to it in Column B. Internationally, about one-fourth of both the third and fourth graders answered that you should subtract 8 from the number in Column A (option B). This response applies only to the first pair of numbers.

Figure 3.6 presents the item difficulty map for the example items in the content area of patterns, relations, and functions. The results indicate that students were more likely to be able to recognize simple patterns and relationships than they were to determine the operations underlying the relationships.

Table 3.26 Patterns, Relations, and Functions

Percent Correct for Example Item 26
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct Third Grade	Percent Correct Fourth Grade
Canada	68 (2.7)	78 (3.3)
Cyprus	40 (3.0)	52 (2.6)
Czech Republic	66 (2.3)	80 (2.3)
[†][2]England	60 (2.3)	75 (2.3)
Greece	29 (3.3)	51 (3.2)
Hong Kong	71 (1.9)	82 (1.9)
Iceland	51 (3.0)	67 (3.6)
Iran, Islamic Rep.	41 (4.0)	54 (3.2)
Ireland	63 (2.4)	75 (2.0)
Japan	87 (1.5)	91 (1.2)
Korea	89 (1.8)	93 (1.4)
New Zealand	59 (3.6)	71 (2.6)
Norway	48 (3.3)	65 (3.0)
Portugal	42 (2.8)	58 (3.0)
[†]Scotland	59 (2.4)	73 (2.3)
Singapore	74 (1.8)	85 (1.4)
United States	67 (2.7)	79 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	64 (4.0)	78 (1.8)
Austria	72 (3.6)	85 (1.8)
[1]Latvia (LSS)	75 (2.6)	82 (2.7)
Netherlands	75 (2.3)	84 (2.3)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	54 (3.2)	75 (2.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	63 (2.8)	80 (2.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	69 (2.8)
Kuwait	- -	44 (2.4)
Thailand	43 (3.6)	55 (2.8)
International Average Percent Correct	61 (0.6)	72 (0.5)
	Seventh Grade	Eighth Grade
	90 (0.4)	**92 (0.3)**

Note: Item also tested at seventh and eighth grades.

Example 26

Shapes in a pattern.

These shapes are arranged in a pattern.

○△○○△△○○○△△△

Which set of shapes is arranged in the same pattern?

A. ★□★□★★□□★★□□
B. □★□□★□□□★□□□□
[✓ C.] ★□★★□□★★★□□□
D. □□★★□★□□★★□★

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.27 Patterns, Relations, and Functions

Percent Correct for Example Item 27
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	**Fourth Grade**
Canada	54 (2.4)	69 (2.5)
Cyprus	47 (2.8)	67 (2.3)
Czech Republic	65 (2.2)	72 (2.6)
[†][2]England	41 (2.8)	56 (2.8)
Greece	42 (3.3)	66 (2.7)
Hong Kong	64 (1.8)	83 (1.9)
Iceland	41 (3.4)	67 (3.2)
Iran, Islamic Rep.	38 (3.1)	62 (2.7)
Ireland	46 (3.0)	65 (2.6)
Japan	79 (1.6)	89 (1.4)
Korea	88 (1.7)	93 (1.4)
New Zealand	43 (3.3)	57 (2.9)
Norway	36 (3.4)	63 (3.3)
Portugal	46 (3.4)	65 (3.1)
[†]Scotland	47 (3.3)	59 (2.5)
Singapore	73 (1.8)	87 (1.4)
United States	58 (3.0)	71 (2.3)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	46 (3.2)	65 (2.0)
Austria	57 (3.2)	74 (2.8)
[1]Latvia (LSS)	72 (3.2)	79 (3.1)
Netherlands	53 (2.7)	70 (2.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	75 (2.7)	86 (1.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	63 (2.8)	79 (2.2)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	77 (2.7)
Kuwait	- -	43 (2.0)
Thailand	52 (3.9)	56 (3.1)
International Average Percent Correct	55 (0.6)	70 (0.5)

Example 27

Make number sentence true.

Here is a number sentence.

$4 \times \square < 17$

Which number could go in the ☐ to make the sentence true?

[✓ A.] 4

B. 5

C. 12

D. 13

---

[*] Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.28 Patterns, Relations, and Functions

Percent Correct for Example Item 28
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	[illegible]	[illegible]
Canada	59 (2.5)	68 (2.9)
Cyprus	48 (2.7)	56 (2.9)
Czech Republic	52 (2.4)	62 (2.4)
[†2]England	54 (3.1)	66 (2.7)
Greece	54 (3.8)	54 (3.0)
Hong Kong	65 (2.1)	74 (2.0)
Iceland	47 (3.9)	61 (4.3)
Iran, Islamic Rep.	41 (2.7)	41 (2.7)
Ireland	61 (2.4)	66 (2.8)
Japan	68 (2.1)	73 (2.1)
Korea	80 (1.9)	86 (1.8)
New Zealand	57 (3.4)	64 (2.9)
Norway	52 (3.2)	66 (3.2)
Portugal	46 (3.0)	54 (2.8)
[†]Scotland	58 (2.6)	65 (2.1)
Singapore	62 (2.0)	72 (1.9)
United States	64 (2.4)	73 (1.7)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	59 (2.8)	70 (2.0)
Austria	52 (3.3)	57 (3.1)
[1]Latvia (LSS)	38 (3.3)	50 (3.3)
Netherlands	56 (2.5)	66 (2.8)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	60 (3.1)	72 (3.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	62 (2.9)	64 (2.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	68 (3.4)
Kuwait	- -	43 (2.7)
Thailand	37 (2.7)	47 (3.6)
International Average Percent Correct	55 (0.6)	63 (0.5)

Example 28

True statement of ages.

Henry is older than Bill, and Bill is older than Peter. Which statement must be true?

[✓ A.] Henry is older than Peter

B. Henry is younger than Peter

C. Henry is the same age as Peter

D. We cannot tell who is oldest from the information.

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.29 Patterns, Relations, and Functions

Percent Correct for Example Item 29
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	38 (2.4)	57 (2.5)
Cyprus	41 (2.6)	67 (2.1)
Czech Republic	42 (2.5)	65 (2.2)
†[2]England	41 (2.1)	57 (1.8)
Greece	27 (2.2)	42 (2.6)
Hong Kong	43 (2.6)	65 (1.9)
Iceland	15 (1.9)	27 (3.0)
Iran, Islamic Rep.	14 (1.5)	22 (1.9)
Ireland	54 (2.8)	74 (1.9)
Japan	40 (1.5)	58 (1.4)
Korea	56 (1.9)	74 (1.7)
New Zealand	34 (1.8)	48 (2.3)
Norway	20 (2.2)	46 (2.2)
Portugal	17 (2.1)	30 (2.3)
†Scotland	44 (2.0)	63 (2.2)
Singapore	73 (1.4)	79 (1.3)
United States	40 (1.9)	61 (2.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	54 (2.1)	72 (1.5)
Austria	41 (2.8)	64 (2.5)
[1]Latvia (LSS)	51 (2.7)	70 (2.5)
Netherlands	58 (2.1)	77 (1.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	46 (2.5)	68 (2.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	62 (2.3)	79 (1.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	46 (2.9)
Kuwait	- -	12 (1.0)
Thailand	- -	- -
International Average Percent Correct	41 (0.5)	57 (0.4)

Example 29

Next number in pattern.

These numbers are part of a pattern.

50 , 46 , 42 , 38 , 34 , ...

What do you have to do to get the next number?

Answer: 30

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for Thailand on Example 29.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.30 Patterns, Relations, and Functions

Percent Correct for Example Item 30
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
Canada	18 (2.0)	38 (2.6)
Cyprus	18 (2.9)	29 (2.3)
Czech Republic	38 (2.6)	57 (3.0)
†[2]England	19 (2.0)	35 (2.7)
Greece	14 (2.0)	24 (2.9)
Hong Kong	- -	- -
Iceland	13 (2.6)	24 (2.9)
Iran, Islamic Rep.	18 (2.6)	29 (3.2)
Ireland	26 (2.8)	38 (2.9)
Japan	36 (2.0)	50 (2.1)
Korea	50 (3.0)	70 (2.2)
New Zealand	20 (2.6)	27 (2.9)
Norway	23 (3.5)	30 (3.5)
Portugal	23 (2.8)	32 (2.6)
†Scotland	24 (2.1)	31 (2.6)
Singapore	45 (2.1)	54 (2.2)
United States	27 (2.9)	32 (2.3)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	25 (2.3)	36 (1.8)
Austria	24 (3.0)	41 (3.8)
[1]Latvia (LSS)	40 (3.5)	53 (3.4)
Netherlands	30 (3.2)	41 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	34 (2.6)	47 (3.1)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	40 (3.0)	56 (2.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	45 (3.5)
Kuwait	- -	20 (2.1)
Thailand	26 (1.9)	37 (2.5)
International Average Percent Correct	27 (0.6)	39 (0.6)

Example 30

Operation to get B from A.

What do you have to do to each number in Column A to get the number next to it in Column B?

Column A	Column B
10	2
15	3
25	5
50	10

A. Add 8 to the number in Column A.

B. Subtract 8 from the number in Column A.

C. Multiply the number in Column A by 5.

[✓ D] Divide the number in Column A by 5.

---

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

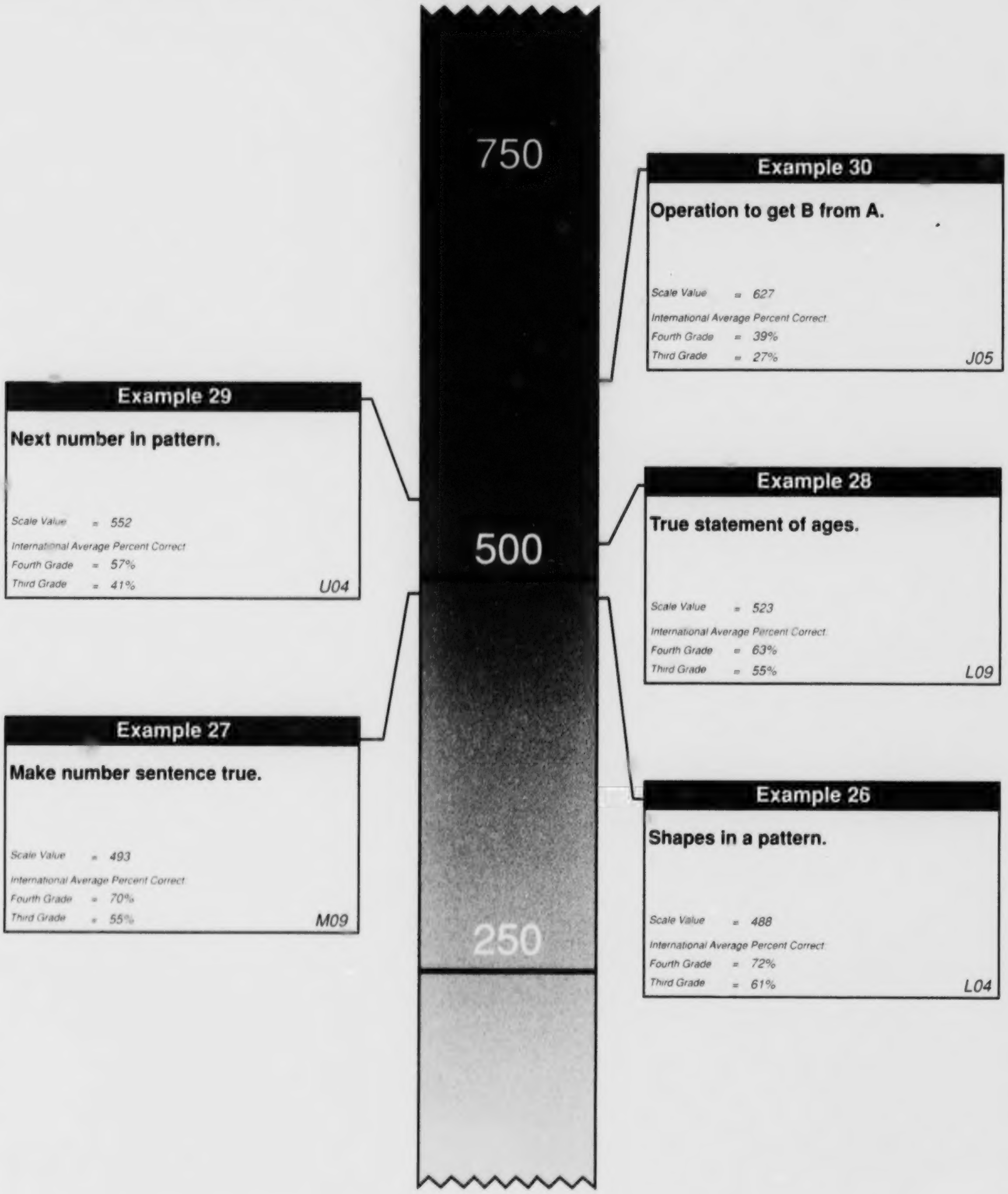
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates data are not available. Israel and Kuwait did not test at the lower grade. Internationally comparable data are not available for Hong Kong in Example 30.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.6

International Difficulty Map for Patterns, Relations, and Functions Example Items Lower and Upper Grades (Third and Fourth Grades*)



Example 30

Operation to get B from A.

Scale Value = 627
International Average Percent Correct
Fourth Grade = 39%
Third Grade = 27%
J05

Example 29

Next number in pattern.

Scale Value = 552
International Average Percent Correct
Fourth Grade = 57%
Third Grade = 41%
U04

Example 28

True statement of ages.

Scale Value = 523
International Average Percent Correct
Fourth Grade = 63%
Third Grade = 55%
L09

Example 27

Make number sentence true.

Scale Value = 493
International Average Percent Correct
Fourth Grade = 70%
Third Grade = 55%
M09

Example 26

Shapes in a pattern.

Scale Value = 488
International Average Percent Correct
Fourth Grade = 72%
Third Grade = 61%
L04

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
NOTE: Each item was placed onto the TIMSS international mathematics scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

Chapter 4

STUDENTS' BACKGROUNDS AND ATTITUDES TOWARDS MATHEMATICS

To provide an educational context for interpreting the mathematics achievement results, TIMSS collected a full range of descriptive information from students about their backgrounds as well as their activities in and out of school. This chapter presents fourth-grade students' responses to a selected subset of these questions. In an effort to explore the degree to which the students' home and social environment fostered academic development, some of the questions presented herein address the availability of educational resources in the home. Another group of questions is provided to help examine whether or not students typically spend their out-of-school time in ways that support their in-school academic performance. Because students' attitudes and opinions about mathematics reflect what happens in school and their perceptions of the value of mathematics in broader social contexts, results also are described for several questions from the affective domain. Specifically, these questions asked students to express their opinions about the abilities necessary for success in mathematics and indicate their attitudes toward mathematics.

WHAT EDUCATIONAL RESOURCES DO STUDENTS HAVE IN THEIR HOMES?

Students specifically were asked about the availability at home of three types of educational resources – a dictionary, a study desk or table for their own use, and a computer. Table 4.1 reveals that in many countries fourth-grade students with all three of these educational study aids had higher mathematics achievement than students who did not have ready access to these study aids. In most countries, a high percentage (80% or more) of students reported having a dictionary in their homes. There was more variation among countries in the percentages of students reporting that they have their own study desk or table. For the three study aids, the greatest variation was in the number of fourth-grade students reporting having a home computer. In about half of the countries, the majority of students reported having a computer in the home, including the 80% or more who so reported in England, Iceland, the Netherlands, and Scotland. It is possible that these percentages include computers used for entertainment purposes, such as computer games. In most countries, however, including these four, the reports of fourth graders were quite consistent with those of their eighth-grade counterparts in TIMSS.[1]

---

[1] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years:, IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

Table 4.1

Students' Reports on Educational Aids in the Home: Dictionary, Study Desk/Table and Computer - Mathematics - Upper Grade (Fourth Grade*)

Country	Have All Three Educational Aids		Do Not Have All Three Educational Aids		Have Dictionary	Have Study Desk Table for Own Use	Have Computer
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Percent of Students	Percent of Students
Australia	50 (1.0)	563 (3.2)	50 (1.0)	530 (3.8)	78 (1.0)	93 (0.6)	63 (1.1)
Austria	50 (1.4)	559 (3.3)	50 (1.4)	561 (4.0)	95 (0.6)	82 (1.2)	61 (1.5)
Canada	41 (1.2)	553 (3.9)	59 (1.2)	517 (3.9)	85 (0.8)	78 (1.0)	52 (1.1)
Cyprus	29 (1.0)	515 (4.4)	71 (1.0)	501 (3.3)	84 (0.8)	89 (0.7)	35 (1.0)
Czech Republic	25 (1.2)	590 (5.2)	75 (1.2)	561 (3.1)	82 (1.0)	78 (0.9)	33 (1.3)
England	68 (1.3)	521 (3.8)	32 (1.3)	494 (4.0)	93 (0.6)	80 (1.0)	88 (0.9)
Greece	20 (1.0)	504 (4.9)	80 (1.0)	494 (4.1)	90 (0.9)	88 (1.0)	23 (1.1)
Hong Kong	31 (1.1)	594 (4.8)	69 (1.1)	584 (4.5)	98 (0.3)	75 (1.2)	37 (1.2)
Hungary	28 (1.4)	582 (5.7)	72 (1.4)	537 (3.3)	69 (1.3)	87 (0.8)	37 (1.4)
Iceland	60 (1.6)	483 (3.5)	40 (1.6)	466 (2.9)	79 (1.3)	92 (0.6)	81 (1.1)
Iran, Islamic Rep.	r 3 (0.5)	442 (10.6)	97 (0.5)	437 (4.3)	r 39 (2.0)	r 34 (2.1)	r 8 (0.8)
Ireland	58 (1.2)	561 (3.6)	42 (1.2)	538 (4.0)	95 (0.5)	74 (1.1)	79 (0.9)
Israel	r 67 (2.0)	540 (4.0)	33 (2.0)	522 (4.9)	r 97 (0.6)	r 95 (0.6)	r 70 (1.9)
Japan	- -	- -	- -	- -	- -	- -	- -
Korea	22 (1.0)	630 (4.4)	78 (1.0)	606 (2.1)	93 (0.6)	91 (0.7)	23 (1.0)
Kuwait	40 (1.6)	413 (3.3)	60 (1.6)	394 (2.8)	70 (1.2)	75 (1.4)	66 (1.3)
Latvia (LSS)	18 (1.2)	520 (6.5)	82 (1.2)	527 (5.2)	84 (1.0)	95 (0.6)	21 (1.3)
Netherlands	69 (1.3)	588 (3.7)	31 (1.3)	563 (3.9)	88 (0.8)	95 (0.7)	80 (1.2)
New Zealand	43 (1.3)	524 (3.9)	57 (1.3)	483 (4.9)	93 (0.7)	78 (1.4)	53 (1.5)
Norway	44 (1.4)	517 (3.1)	56 (1.4)	491 (3.4)	76 (1.2)	92 (0.8)	56 (1.3)
Portugal	26 (1.4)	503 (4.1)	74 (1.4)	468 (3.9)	89 (1.1)	64 (1.5)	34 (1.7)
Scotland	64 (1.1)	534 (3.8)	36 (1.1)	502 (4.4)	91 (0.9)	75 (1.1)	89 (0.6)
Singapore	40 (1.3)	653 (6.0)	60 (1.3)	606 (4.9)	96 (0.3)	89 (0.5)	44 (1.3)
Slovenia	36 (1.4)	569 (4.1)	64 (1.4)	544 (3.6)	82 (1.0)	87 (0.9)	43 (1.3)
Thailand	1 (0.5)	~ ~	99 (0.5)	488 (4.4)	35 (2.6)	33 (2.2)	3 (0.6)
United States	49 (1.5)	563 (3.2)	51 (1.5)	529 (3.1)	93 (0.5)	85 (0.7)	56 (1.6)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

The number of books in the home can be an indicator of a home environment that values literacy and the acquisition of knowledge, and offers general academic support. Table 4.2 presents fourth-grade students' reports about the number of books in their homes in relation to their achievement on the TIMSS mathematics test. In nearly all countries, students reporting more than 100 books in the home had higher mathematics achievement than students reporting fewer books. Although the main purpose of the question was to gain some information about the relative importance of academic pursuits in the students' home environments rather than to determine the actual number of books in students' homes, there was a substantial amount of variation from country to country in fourth-grade students' reports about the number of books in their homes. In Hong Kong, Iran, Kuwait, Portugal, and Thailand, half or more of the students reported 25 or fewer books in the home. In comparison, more than 40% of the students in Australia and Latvia (LSS) reported more than 200 books in their homes. The number of books in the home reported by fourth-grade students in most countries agreed well with the number reported by their compatriots in eighth grade, although there was a tendency for fourth-grade students to report a lower number than eighth-grade students in some countries, notably Iran, Portugal, and Thailand.

Students who speak a language at home that is different from the language of the school may sometimes be at a disadvantage in learning situations, particularly in the early grades of school. Table 4.3 presents fourth graders' responses to the question of how often they spoke the language of the TIMSS mathematics test at home. In all but a few of the countries, 80% or more of the students responded that at home they always or almost always spoke the language in which they were tested, and in eight of those countries 90% or more of the students so responded. Most certainly, these relatively high percentages reflect the effort expended by the participating countries to test in more than one language when necessary. However, in some countries, such as Iran, Kuwait, and Thailand, testing in all possible dialects and languages was prohibitive. Interestingly, all students in Singapore were tested in English, even though for most them, English is only sometimes (71%) or never (9%) spoken in the home. In most of the countries, students tested in the language almost always spoken in the home had higher mathematics achievement than their counterparts who reported speaking the language of the test only sometimes or never.

Table 4.2

Students' Reports on the Number of Books in the Home Mathematics - Upper Grade (Fourth Grade*)

Country	None or Very Few (0-10 Books)		About One Shelf (11-25 Books)		About One Bookcase (26-100 Books)		About Two Bookcases (101-200 Books)		Three or More Bookcases (More than 200 Books)	
Australia	3 (0.4)	461 (8.2)	7 (0.4)	503 (6.6)	23 (0.7)	544 (3.8)	24 (0.6)	551 (3.7)	44 (1.0)	563 (3.4)
Austria	9 (0.8)	512 (8.5)	17 (0.9)	531 (4.6)	35 (1.7)	567 (4.7)	18 (1.2)	579 (4.8)	21 (1.5)	584 (4.3)
Canada	5 (0.6)	472 (9.4)	13 (1.0)	513 (3.8)	29 (0.9)	541 (3.9)	20 (0.6)	546 (3.8)	33 (1.3)	536 (4.0)
Cyprus	11 (0.7)	476 (5.8)	26 (1.2)	502 (4.0)	28 (1.2)	518 (4.2)	16 (0.9)	527 (5.1)	19 (1.0)	519 (4.5)
Czech Republic	2 (0.3)	~ ~	10 (0.7)	529 (4.9)	38 (1.3)	557 (3.5)	25 (1.0)	579 (4.0)	25 (1.2)	599 (5.4)
England	7 (0.6)	451 (5.1)	13 (0.9)	475 (4.4)	26 (1.0)	505 (3.5)	23 (1.0)	533 (5.8)	31 (1.2)	537 (4.5)
Greece	r 11 (1.2)	450 (7.4)	27 (1.2)	493 (4.1)	36 (1.3)	517 (3.6)	15 (1.0)	527 (8.2)	12 (0.8)	530 (9.0)
Hong Kong	23 (1.2)	569 (5.3)	27 (0.9)	584 (4.5)	28 (1.2)	605 (4.3)	11 (0.7)	599 (6.6)	11 (1.0)	594 (5.0)
Hungary	5 (0.6)	493 (8.1)	11 (0.7)	508 (4.2)	30 (1.3)	543 (4.4)	19 (0.8)	567 (6.0)	35 (1.6)	579 (4.5)
Iceland	2 (0.4)	~ ~	12 (0.9)	451 (6.1)	30 (1.1)	470 (3.7)	24 (1.3)	483 (3.5)	33 (1.0)	490 (4.4)
Iran, Islamic Rep.	54 (2.4)	418 (3.6)	24 (1.6)	449 (4.3)	11 (1.1)	458 (7.8)	3 (0.4)	451 (9.1)	7 (0.8)	469 (8.0)
Ireland	9 (0.8)	487 (6.6)	19 (1.1)	532 (5.0)	30 (0.9)	559 (3.9)	20 (1.0)	573 (3.5)	23 (1.2)	573 (4.9)
Israel	r 6 (0.6)	521 (9.2)	18 (1.5)	526 (6.5)	36 (1.2)	534 (3.5)	19 (1.2)	545 (6.5)	20 (1.3)	536 (6.3)
Japan	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Korea	11 (0.6)	568 (4.1)	11 (0.6)	579 (4.4)	32 (1.0)	606 (2.4)	25 (0.8)	627 (3.2)	22 (0.9)	636 (3.5)
Kuwait	27 (1.4)	386 (2.6)	24 (1.0)	400 (2.8)	22 (1.2)	412 (3.4)	9 (0.6)	424 (3.8)	17 (1.2)	422 (4.8)
Latvia (LSS)	4 (0.4)	479 (9.3)	8 (0.7)	509 (8.2)	25 (1.3)	533 (9.2)	21 (1.0)	531 (6.0)	42 (1.7)	538 (4.4)
Netherlands	6 (0.8)	536 (10.4)	13 (0.9)	548 (4.7)	33 (1.3)	577 (3.8)	23 (1.2)	594 (3.6)	25 (1.6)	595 (5.0)
New Zealand	7 (0.8)	416 (8.3)	9 (0.7)	454 (6.1)	22 (1.2)	499 (5.9)	23 (1.0)	520 (4.9)	39 (1.7)	521 (4.6)
Norway	3 (0.5)	446 (10.0)	10 (0.7)	467 (4.5)	27 (1.0)	492 (3.6)	23 (0.9)	514 (3.8)	37 (1.2)	521 (3.7)
Portugal	28 (1.9)	445 (5.8)	29 (1.3)	479 (3.3)	25 (1.3)	503 (3.3)	9 (0.8)	513 (5.3)	9 (1.1)	520 (7.8)
Scotland	10 (1.0)	451 (6.2)	15 (1.0)	490 (4.4)	25 (1.0)	522 (4.5)	20 (0.9)	541 (5.0)	31 (1.5)	556 (4.8)
Singapore	9 (0.6)	553 (5.1)	21 (0.9)	583 (5.5)	36 (0.8)	635 (4.5)	18 (0.8)	660 (5.9)	16 (1.1)	666 (8.1)
Slovenia	6 (0.8)	485 (6.9)	20 (1.2)	524 (4.6)	37 (1.2)	558 (3.8)	18 (0.9)	578 (4.5)	18 (1.3)	574 (6.3)
Thailand	47 (2.1)	477 (4.6)	28 (1.1)	492 (5.2)	17 (1.1)	504 (5.8)	4 (0.6)	523 (8.0)	4 (0.5)	513 (12.5)
United States	8 (0.6)	473 (4.7)	13 (0.7)	506 (3.3)	24 (0.7)	546 (3.0)	22 (0.6)	562 (4.9)	34 (1.2)	567 (2.6)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.3

Students' Reports on Frequency with Which They Speak the Language of the Test at Home - Mathematics - Upper Grade (Fourth Grade*)

Country	Never		Sometimes		Always or Almost Always	
	Percent of Students	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	**Percent of Students**	**Mean Achievement**
Australia	1 (0.2)	~ ~	9 (0.9)	524 (10.9)	89 (1.0)	550 (2.8)
Austria	s 3 (0.6)	523 (21.6)	14 (1.2)	502 (6.2)	83 (1.5)	566 (3.9)
Canada	1 (0.2)	~ ~	13 (1.2)	501 (5.2)	86 (1.2)	539 (3.4)
Cyprus	3 (0.4)	478 (9.2)	9 (0.8)	500 (7.3)	88 (0.9)	507 (3.0)
Czech Republic	1 (0.2)	~ ~	3 (0.5)	539 (9.7)	96 (0.5)	569 (3.3)
England	1 (0.2)	~ ~	6 (0.8)	477 (9.0)	93 (0.8)	516 (3.4)
Greece	r 2 (0.4)	~ ~	7 (0.7)	448 (9.6)	90 (0.9)	502 (3.8)
Hong Kong	- -	- -	- -	- -	- -	- -
Hungary	x x	x x	x x	x x	x x	x x
Iceland	1 (0.3)	~ ~	10 (0.9)	476 (6.0)	89 (1.0)	477 (2.9)
Iran, Islamic Rep.	23 (2.2)	403 (4.3)	22 (1.7)	421 (6.8)	54 (2.8)	444 (5.0)
Ireland	3 (0.3)	467 (6.0)	5 (0.6)	504 (9.7)	92 (0.8)	557 (3.3)
Israel	r 2 (0.3)	~ ~	15 (1.2)	527 (6.6)	83 (1.2)	535 (4.0)
Japan	- -	- -	- -	- -	- -	- -
Korea	1 (0.1)	~ ~	10 (0.7)	603 (4.6)	89 (0.7)	613 (2.3)
Kuwait	13 (1.5)	395 (3.9)	37 (2.2)	403 (2.8)	50 (2.4)	403 (3.8)
Latvia (LSS)	1 (0.3)	~ ~	7 (0.8)	491 (7.5)	92 (0.8)	530 (5.1)
Netherlands	5 (0.9)	563 (6.8)	11 (1.4)	553 (7.3)	84 (1.7)	585 (3.6)
New Zealand	2 (0.2)	~ ~	11 (1.0)	450 (8.0)	87 (1.1)	509 (4.3)
Norway	r 2 (0.3)	~ ~	8 (0.9)	460 (8.3)	90 (1.0)	507 (3.0)
Portugal	r 2 (0.3)	~ ~	4 (0.5)	465 (9.4)	94 (0.5)	478 (3.7)
Scotland	- -	- -	- -	- -	- -	- -
Singapore	9 (0.6)	567 (6.9)	71 (1.3)	618 (4.4)	20 (1.5)	676 (7.9)
Slovenia	1 (0.2)	~ ~	9 (0.9)	520 (5.3)	90 (1.0)	556 (3.6)
Thailand	11 (1.6)	457 (10.8)	29 (2.4)	483 (4.9)	60 (2.9)	498 (5.3)
United States	2 (0.2)	~ ~	13 (1.1)	508 (4.6)	85 (1.1)	553 (3.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student response rate.
An "x" indicates data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.4 presents information about whether students' parents were born in the country. In about half the participating countries, 80% or more of the fourth graders reported that both their parents were born in that country. In Australia, Canada, Hong Kong, Israel, New Zealand, and Singapore, 30% or more of the students reported that at least one parent was not born in the country. The patterns in relation to achievement varied substantially from country to country. In several countries, there was no relationship between the number of the students' parents born in the country and mathematics achievement (e.g., Australia, Israel, and New Zealand). In about one-third of the countries, students having both parents born in the country had the highest achievement and, in turn, those with one parent born in the country outperformed their counterparts with neither parent born in the country (e.g., Greece, the Netherlands, and the United States).

As shown in Table 4.5, most of the students reported having been born in the country in which they were tested. The largest percentages of students reporting that they had not been born in the country (from 10% to 18%) were in Cyprus, Hong Kong, Iceland, Israel, Kuwait, the Netherlands, New Zealand, and Scotland. For about half the countries, those students born elsewhere had lower average mathematics achievement than their classmates born in the country.

Table 4.4

Students' Reports on Whether or Not Their Parents Were Born in the Country - Mathematics - Upper Grade (Fourth Grade*)

Country	Neither Parent Born in Country		One Parent Born in Country		Both Parents Born in Country	
	Percent of Students	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	**Percent of Students**	**Mean Achievement**
Australia	19 (1.2)	545 (7.7)	20 (0.9)	548 (4.2)	61 (1.1)	549 (3.3)
Austria	11 (0.9)	514 (8.2)	9 (0.7)	557 (7.0)	80 (1.2)	566 (2.7)
Canada	17 (1.5)	515 (4.7)	14 (0.5)	520 (5.9)	69 (1.6)	542 (3.5)
Cyprus	3 (0.4)	464 (8.3)	11 (0.8)	491 (6.1)	85 (0.9)	508 (3.0)
Czech Republic	2 (0.3)	~ ~	8 (0.6)	546 (6.1)	89 (0.7)	571 (3.3)
England	r 9 (1.2)	495 (12.2)	15 (0.9)	510 (6.4)	76 (1.8)	518 (3.7)
Greece	5 (0.6)	450 (8.2)	10 (0.9)	478 (6.7)	85 (1.0)	500 (3.8)
Hong Kong	38 (1.8)	588 (5.1)	21 (0.9)	592 (4.8)	41 (1.8)	586 (4.6)
Hungary	2 (0.3)	~ ~	3 (0.3)	528 (12.4)	95 (0.4)	550 (3.7)
Iceland	1 (0.2)	~ ~	6 (0.6)	477 (10.2)	93 (0.7)	476 (2.8)
Iran, Islamic Rep.	r 5 (0.7)	426 (4.9)	4 (0.4)	416 (5.9)	91 (0.8)	436 (4.4)
Ireland	2 (0.3)	~ ~	10 (0.7)	543 (6.1)	88 (0.8)	552 (3.4)
Israel	r 32 (2.2)	531 (5.3)	24 (1.2)	534 (5.1)	44 (1.9)	535 (4.3)
Japan	- -	- -	- -	- -	- -	- -
Korea	0 (0.1)	~ ~	1 (0.2)	~ ~	99 (0.2)	611 (2.1)
Kuwait	10 (0.7)	416 (5.2)	16 (0.7)	394 (3.9)	74 (1.1)	401 (2.9)
Latvia (LSS)	2 (0.3)	~ ~	16 (0.9)	516 (5.5)	82 (0.9)	529 (5.1)
Netherlands	r 8 (1.7)	538 (9.5)	6 (0.6)	565 (8.3)	86 (1.6)	585 (3.2)
New Zealand	11 (0.9)	490 (6.4)	21 (1.0)	502 (5.5)	68 (1.4)	502 (4.9)
Norway	4 (0.7)	456 (7.9)	7 (0.5)	494 (7.7)	89 (1.0)	505 (2.9)
Portugal	5 (0.6)	445 (8.2)	8 (0.6)	478 (6.3)	86 (0.9)	478 (3.6)
Scotland	9 (0.9)	540 (8.0)	19 (0.9)	524 (4.9)	72 (1.4)	520 (4.2)
Singapore	12 (0.6)	635 (5.6)	21 (0.5)	622 (6.0)	68 (0.7)	625 (5.6)
Slovenia	12 (1.2)	530 (5.3)	9 (0.6)	559 (6.7)	79 (1.4)	555 (3.6)
Thailand	2 (0.4)	~ ~	3 (0.3)	438 (9.6)	96 (0.6)	491 (4.4)
United States	12 (1.2)	508 (5.9)	10 (0.7)	531 (4.5)	78 (1.3)	553 (3.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.5

Students' Reports on Whether or Not They Were Born in the Country Mathematics - Upper Grade (Fourth Grade*)

Country	Yes		No	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	91 (0.9)	547 (3.1)	9 (0.9)	543 (8.9)
Austria	91 (1.3)	563 (2.9)	9 (1.3)	527 (16.4)
Canada	93 (0.7)	536 (3.1)	7 (0.7)	500 (8.0)
Cyprus	88 (0.9)	505 (2.9)	12 (0.9)	501 (6.3)
Czech Republic	98 (0.2)	568 (3.2)	2 (0.2)	~ ~
England	93 (0.7)	516 (3.4)	7 (0.7)	463 (6.2)
Greece	92 (0.6)	498 (3.8)	8 (0.6)	463 (8.1)
Hong Kong	82 (2.0)	590 (4.4)	18 (2.0)	574 (6.6)
Hungary	98 (0.3)	551 (3.8)	2 (0.3)	~ ~
Iceland	87 (2.3)	475 (2.5)	13 (2.3)	476 (9.1)
Iran, Islamic Rep.	92 (0.8)	433 (4.1)	8 (0.8)	395 (4.7)
Ireland	96 (0.5)	551 (3.5)	4 (0.5)	545 (9.1)
Israel	r 84 (1.5)	535 (3.8)	16 (1.5)	525 (6.5)
Japan	- -	- -	- -	- -
Korea	99 (0.2)	611 (2.1)	1 (0.2)	~ ~
Kuwait	87 (1.0)	400 (2.5)	13 (1.0)	406 (6.2)
Latvia (LSS)	97 (0.5)	528 (5.0)	3 (0.5)	475 (6.6)
Netherlands	89 (0.9)	584 (3.4)	11 (0.9)	550 (7.9)
New Zealand	90 (0.7)	500 (4.4)	10 (0.7)	496 (9.1)
Norway	96 (0.5)	504 (2.9)	4 (0.5)	464 (9.2)
Portugal	94 (0.6)	479 (3.4)	6 (0.6)	440 (9.6)
Scotland	90 (0.8)	521 (4.0)	10 (0.8)	523 (8.7)
Singapore	93 (0.6)	624 (5.4)	7 (0.6)	638 (6.6)
Slovenia	96 (0.5)	554 (3.3)	4 (0.5)	513 (9.8)
Thailand	100 (0.0)	489 (4.5)	0 (0.0)	~ ~
United States	93 (0.5)	550 (3.0)	7 (0.5)	494 (4.7)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE THE ACADEMIC EXPECTATIONS OF STUDENTS, THEIR FAMILIES, AND THEIR FRIENDS?

Tables 4.6, 4.7, and 4.8 present fourth-grade students' reports about how they themselves, their mothers, and their friends feel about the importance of doing well in mathematics and science in comparison with non-academic activities. In almost every country, nearly all fourth graders agreed or strongly agreed that it was important to do well in mathematics. The percentages were in the high 90s for many countries and exceeded 90% in all countries, except Japan (75%), Korea (72%), and Thailand (80%). In many countries, somewhat fewer fourth-grade students agreed with the importance of doing well in science. Still, the percentages were relatively high, ranging from more than 90% agreement in a number of countries to a low of 72% in Japan and 69% in Korea.

For the most part, fourth-grade students indicated that their mothers' opinions about the importance of these academic activities corresponded very closely to their own feelings. In contrast, however, students reported that their friends were not in as much agreement about the importance of academic success. Although students' friends purportedly were in general agreement with the importance of doing well in mathematics, the percentages were generally in the 70s and 80s rather than the 90s as for the students themselves. According to students, their friends were in the lowest degree of agreement about doing well in mathematics in Korea (59%). According to students, their friends felt even somewhat less strongly about the importance of doing well in science. The percentage of students reporting that their friends thought it was important to do well in science ranged from a high of about 90% in Greece and Portugal to a low of 54% in the Netherlands.

For purposes of comparison, fourth-grade students also were asked about the importance of two non-academic activities – having time to have fun and being good at sports. In about two-thirds of the countries, more than 90% of the fourth graders agreed that it was important to have fun. At the lower end of the range, about three-fourths of the students in Korea and Kuwait agreed with the importance of having fun and the fewest agreed in Hong Kong (58%) and Singapore (57%). The variation in fourth-grade responses is interesting in view of the responses provided by the eighth-grade students, who nearly universally (usually 95% or more) agreed that it was important to have fun. Generally, there was less agreement about the importance of being good at sports, which was rather similar to the level of agreement about the importance of doing well in science. It needs to be emphasized, however, that the relative rankings given to the four activities by students varied from country to country.

In nearly all countries, 75% or more of the fourth-grade students reported that their mothers agreed that it was important to have time to have fun. The exceptions were Hong Kong (31%), Korea (66%), Kuwait (71%), and Singapore (46%). According to students, their mothers give a moderate to high degree of support to the importance of being good at sports (from 67% to 90%), except in Hong Kong (36%) and Thailand (57%).

As might be anticipated, students reported that most of their friends agreed that it was important to have fun – more than 90% in all countries except Cyprus (79%), Greece (82%), Hong Kong (65%), Iran (76%), Israel (76%), Korea (78%), Kuwait (75%), Singapore (65%), and Thailand (84%). Internationally, fourth graders reported that their friends generally were in moderate agreement that it was important to do well in sports. The percentages of their friends' agreement as reported by students ranged from a low of 59% in Hong Kong to a high of 91% in Slovenia.

Table 4.6

Students' Reports on Whether They Think It Is Important to Do Various Activities - Mathematics - Upper Grade (Fourth Grade*)

Country	Percent of Students Responding Yes			
	Do Well in Mathematics	**Do Well in Science**	**Have Time to Have Fun**	**Be Good at Sports**
Australia	95 (0.4)	91 (0.8)	95 (0.4)	88 (0.6)
Austria	95 (0.6)	94 (0.6)	92 (0.7)	87 (1.1)
Canada	97 (0.3)	95 (0.5)	96 (0.5)	83 (0.7)
Cyprus	97 (0.4)	93 (0.6)	85 (1.1)	88 (1.0)
Czech Republic	96 (0.4)	96 (0.4)	94 (0.5)	88 (0.8)
England	97 (0.4)	94 (0.6)	93 (0.5)	90 (0.7)
Greece	97 (0.4)	96 (0.6)	80 (1.2)	80 (1.0)
Hong Kong	96 (0.4)	90 (0.9)	58 (1.3)	63 (1.3)
Hungary	98 (0.3)	97 (0.3)	98 (0.3)	86 (0.8)
Iceland	96 (0.5)	87 (1.6)	91 (0.8)	93 (0.7)
Iran, Islamic Rep.	96 (0.5)	97 (0.5)	r 80 (1.7)	r 91 (1.1)
Ireland	97 (0.4)	90 (0.8)	96 (0.3)	90 (0.7)
Israel	r 97 (0.5)	r 94 (0.6)	r 94 (0.8)	r 92 (0.8)
Japan	75 (0.8)	72 (0.9)	94 (0.4)	75 (0.7)
Korea	72 (1.0)	69 (1.0)	73 (1.0)	73 (1.0)
Kuwait	96 (0.5)	95 (0.5)	75 (1.2)	80 (1.3)
Latvia (LSS)	96 (0.4)	93 (0.6)	92 (0.7)	88 (1.0)
Netherlands	93 (0.7)	84 (1.2)	r 93 (0.8)	86 (1.1)
New Zealand	96 (0.5)	90 (0.7)	95 (0.7)	91 (0.6)
Norway	94 (0.6)	91 (1.0)	97 (0.4)	80 (0.9)
Portugal	94 (0.6)	94 (0.7)	90 (0.9)	89 (1.0)
Scotland	97 (0.3)	93 (0.6)	94 (0.5)	92 (0.5)
Singapore	98 (0.2)	94 (0.4)	57 (1.6)	81 (0.9)
Slovenia	94 (0.6)	94 (0.6)	89 (0.7)	92 (0.6)
Thailand	80 (1.3)	79 (1.3)	81 (1.1)	67 (1.4)
United States	98 (0.3)	97 (0.3)	94 (0.4)	82 (0.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.7

Students' Reports on Whether Their Mothers Think It Is Important to Do Various Activities - Mathematics - Upper Grade (Fourth Grade*)

Country	Percent of Students Responding Yes			
	Do Well in Mathematics	Do Well in Science	Have Time to Have Fun	Be Good at Sports
Australia	96 (0.3)	91 (0.8)	92 (0.6)	82 (0.7)
Austria	96 (0.5)	93 (0.5)	88 (0.9)	74 (1.5)
Canada	98 (0.3)	95 (0.3)	92 (0.7)	74 (0.9)
Cyprus	96 (0.5)	91 (0.7)	80 (1.5)	80 (1.1)
Czech Republic	96 (0.5)	95 (0.5)	91 (0.7)	81 (0.9)
England	98 (0.3)	94 (0.6)	90 (0.8)	87 (0.9)
Greece	96 (0.5)	96 (0.4)	75 (1.4)	72 (1.3)
Hong Kong	95 (0.4)	80 (0.9)	31 (1.0)	36 (1.2)
Hungary	97 (0.4)	96 (0.4)	99 (0.2)	77 (1.0)
Iceland	98 (0.4)	88 (1.4)	83 (1.3)	90 (0.8)
Iran, Islamic Rep.	r 96 (0.7)	r 96 (0.6)	r 76 (1.7)	r 85 (1.3)
Ireland	98 (0.3)	91 (0.8)	95 (0.5)	84 (0.8)
Israel	r 97 (0.5)	r 93 (0.7)	r 88 (1.0)	r 76 (1.4)
Japan	- -	- -	- -	- -
Korea	70 (1.1)	64 (1.2)	66 (1.3)	67 (0.9)
Kuwait	94 (0.5)	94 (0.7)	71 (1.5)	71 (1.4)
Latvia (LSS)	95 (0.6)	92 (0.5)	85 (1.2)	80 (1.0)
Netherlands	92 (0.6)	78 (1.3)	85 (1.4)	72 (1.3)
New Zealand	95 (0.5)	90 (0.8)	92 (0.8)	87 (1.2)
Norway	96 (0.5)	94 (0.6)	96 (0.6)	73 (1.2)
Portugal	93 (0.6)	93 (0.8)	87 (1.0)	82 (1.1)
Scotland	98 (0.3)	93 (0.6)	93 (0.5)	87 (0.8)
Singapore	96 (0.4)	91 (0.6)	46 (1.4)	70 (1.1)
Slovenia	89 (0.8)	88 (0.9)	83 (0.9)	86 (0.9)
Thailand	79 (1.2)	79 (1.3)	76 (1.2)	57 (1.8)
United States	98 (0.2)	98 (0.2)	88 (0.8)	69 (0.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Data are reported as percent of students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.8

Students' Reports on Whether Their Friends Think That It Is Important to Do Various Activities - Mathematics - Upper Grade (Fourth Grade*)

Country		Percent of Students Responding Yes						
		Do Well in Mathematics		Do Well in Science		Have Time to Have Fun		Be Good at Sports
Australia		76 (0.8)		68 (0.9)		[illegible]		[illegible]
Austria		83 (1.4)		76 (1.6)		91 (0.8)		82 (1.2)
Canada		81 (0.8)		73 (1.0)		96 (0.4)		82 (0.7)
Cyprus		85 (0.8)		75 (1.4)		79 (1.1)		83 (0.9)
Czech Republic		88 (0.9)		85 (1.1)		93 (0.6)		84 (1.0)
England		78 (1.2)		71 (1.3)		93 (0.6)		88 (0.7)
Greece		93 (0.6)		90 (0.8)		82 (1.1)		76 (1.1)
Hong Kong		84 (1.2)		73 (1.2)		65 (1.0)		59 (1.0)
Hungary		84 (0.9)		80 (1.0)		94 (0.6)		80 (1.1)
Iceland		87 (1.0)		75 (1.9)		92 (0.9)		88 (0.9)
Iran, Islamic Rep.	r	87 (1.7)		87 (1.7)	r	76 (1.9)	r	83 (1.6)
Ireland		79 (1.2)		68 (1.6)		96 (0.4)		90 (0.6)
Israel	r	70 (1.5)	r	65 (1.5)	r	76 (1.2)	r	78 (0.9)
Japan		70 (0.7)		62 (0.9)		92 (0.4)		75 (0.7)
Korea		59 (1.1)		58 (1.0)		78 (1.1)		64 (0.9)
Kuwait		88 (1.0)		86 (1.2)		75 (1.4)		76 (1.2)
Latvia (LSS)		88 (1.0)		78 (1.2)		92 (0.6)		82 (1.2)
Netherlands		65 (2.0)		54 (2.1)		92 (0.7)		72 (1.5)
New Zealand		76 (1.2)		67 (1.3)		96 (0.6)		88 (0.9)
Norway		83 (1.3)		77 (1.4)		97 (0.5)		82 (1.0)
Portugal		91 (0.8)		91 (0.8)		93 (0.6)		88 (1.0)
Scotland		78 (1.0)		68 (1.2)		95 (0.5)		89 (0.8)
Singapore		94 (0.4)		87 (0.7)		65 (1.6)		81 (1.0)
Slovenia		89 (0.8)		86 (0.9)		90 (0.6)		91 (0.8)
Thailand		76 (1.4)		74 (1.5)		84 (1.1)		63 (1.4)
United States		72 (0.9)		69 (0.8)		95 (0.4)		83 (0.9)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Data are reported as percent of students.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

HOW DO STUDENTS SPEND THEIR OUT-OF-SCHOOL TIME DURING THE SCHOOL WEEK?

Even though education may be thought to be the dominant activity of school-aged children, young people actually spend much more of their time outside of school. Some of this out-of-school time is spent at furthering academic development – for example, in studying or doing homework. Table 4.9 presents fourth-grade students' reports about the number of hours outside of school they spend studying or doing homework in mathematics on a normal school day. Fourth-grade students in most countries reported normally averaging approximately an hour (.7 to 1.3 of an hour) studying mathematics. Fourth-graders in the Netherlands, Norway, and Scotland were at the lower end of the range, reporting an average of about one-half hour per school day (.5 to .6 of an hour). About one-fourth of the students in Norway and Scotland and nearly half in the Netherlands reported that they normally spent no time outside of school studying mathematics. Those in Iran and Kuwait were at the top end, reporting about two hours of mathematics homework per school day.

Table 4.9 also shows the relationship between time spent studying mathematics outside of school and students' average mathematics achievement. The relationship was curvilinear in most countries, with the highest achievement being associated with a moderate amount of homework per day (less than one hour). This pattern suggests that, compared with their higher-achieving counterparts, the lower-performing students may do less homework, either because they do not do it or because their teachers do not assign it, or more homework, perhaps because they need to spend the extra time to keep up academically. In only Iran, Japan, and Korea did students who reported progressively more time studying mathematics outside of school have correspondingly higher average mathematics achievement. The only inverse relationship was noted for the Netherlands. Still, different countries clearly have different policies and practices about assigning homework and encouraging the study of mathematics outside of school.

The students also were asked about a variety of other ways they could spend their time out of school. Fourth graders were asked about watching television, playing computer games, playing or talking with friends, doing jobs at home, playing sports, and reading books for enjoyment. Their reports about the average amount of time spent on a normal school day in each of these activities are shown in Table 4.10. Granted, some television programming and some computer games are targeted at developing children's academic abilities, and leisure reading also can be related to higher academic achievement. Still, much fare on television is not educationally related, and fourth-grade students in all countries reported that they normally spent an hour or two each school day watching television. Across countries, students often reported watching from 1.5 to 2 hours per normal school day, with those in Hungary, Israel, and Latvia (LSS), reporting from 2.3 to 2.5 hours. Fourth graders in many countries also appear to spend from one to two hours per school day playing or talking with

Table 4.9

Students' Reports on the Amount of Out-of-School Time Spent Studying Mathematics or Doing Mathematics Homework on a Normal School Day Mathematics - Upper Grade (Fourth Grade*)

Country	No Time		Less than 1 Hour		1 Hour or More		Average Hours[1]
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	
Australia	15 (0.9)	526 (5.6)	61 (1.2)	559 (3.2)	24 (1.0)	530 (4.4)	0.8 (0.02)
Austria	4 (0.7)	555 (8.6)	58 (1.8)	571 (3.8)	38 (1.6)	546 (4.1)	1.0 (0.03)
Canada	14 (1.1)	526 (4.4)	60 (1.4)	544 (4.0)	26 (1.2)	522 (5.0)	0.8 (0.02)
Cyprus	9 (0.7)	473 (6.1)	51 (1.9)	519 (3.6)	40 (1.6)	495 (3.8)	1.1 (0.03)
Czech Republic	9 (0.9)	547 (6.6)	69 (1.2)	576 (3.6)	22 (1.1)	560 (4.3)	0.7 (0.02)
England	- -	- -	- -	- -	- -	- -	- -
Greece	6 (0.5)	453 (6.8)	38 (1.6)	512 (4.1)	56 (1.7)	493 (4.0)	1.6 (0.04)
Hong Kong	6 (0.7)	550 (7.9)	44 (1.2)	595 (4.2)	50 (1.2)	586 (4.5)	1.3 (0.03)
Hungary	5 (0.7)	543 (10.8)	58 (1.3)	563 (3.9)	37 (1.4)	533 (4.2)	1.0 (0.03)
Iceland	10 (0.8)	457 (4.3)	63 (1.4)	483 (3.5)	27 (1.4)	472 (3.2)	0.8 (0.02)
Iran, Islamic Rep.	r 5 (0.7)	402 (6.6)	17 (1.3)	433 (6.0)	78 (1.5)	443 (4.5)	r 2.3 (0.07)
Ireland	7 (0.6)	516 (7.1)	70 (1.3)	565 (3.2)	23 (1.2)	530 (4.9)	0.8 (0.02)
[2] *Israel*	r 14 (1.3)	525 (6.4)	46 (2.2)	535 (4.7)	40 (1.9)	528 (4.1)	r 1.1 (0.05)
Japan	10 (0.7)	558 (4.3)	60 (1.1)	598 (2.3)	31 (1.2)	610 (3.0)	0.9 (0.02)
Korea	14 (0.8)	593 (4.2)	44 (1.1)	610 (2.5)	42 (1.2)	621 (2.3)	1.0 (0.02)
Kuwait	5 (0.7)	372 (5.7)	34 (1.4)	410 (3.0)	60 (1.5)	401 (2.8)	1.9 (0.05)
[2] *Latvia (LSS)*	7 (0.7)	476 (7.5)	61 (1.9)	542 (6.3)	33 (1.7)	518 (5.1)	1.0 (0.03)
Netherlands	47 (2.7)	593 (4.3)	39 (2.3)	578 (3.6)	14 (1.5)	541 (6.1)	0.5 (0.03)
New Zealand	21 (1.6)	488 (9.7)	54 (1.7)	512 (4.4)	25 (1.4)	493 (5.2)	0.8 (0.03)
Norway	23 (1.3)	503 (4.1)	58 (1.2)	512 (3.3)	19 (1.1)	497 (5.3)	0.6 (0.02)
Portugal	3 (0.5)	420 (9.1)	55 (1.7)	489 (3.9)	42 (1.6)	470 (3.9)	1.3 (0.03)
Scotland	26 (1.8)	519 (7.2)	63 (2.0)	528 (3.8)	11 (1.0)	501 (8.9)	0.5 (0.02)
Singapore	- -	- -	- -	- -	- -	- -	- -
Slovenia	3 (0.4)	502 (11.4)	57 (1.5)	563 (3.7)	40 (1.4)	548 (3.7)	1.0 (0.03)
Thailand	17 (1.3)	470 (4.3)	44 (1.6)	496 (4.5)	39 (1.8)	489 (6.1)	1.0 (0.03)
United States	8 (0.5)	516 (4.4)	60 (1.1)	561 (3.1)	32 (1.1)	528 (2.9)	1.0 (0.03)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours =1.5; 3-4 hours = 3.5; More than 4 hours = 5.

[2] Modified response categories for Israel and Latvia: 3-5 hours = 4; More than 5 hours = 7.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

BEST COPY AVAILA

Table 4.10

Students' Reports on How They Spend Their Leisure Time on a Normal School Day[1] - Mathematics - Upper Grade (Fourth Grade*)

Country	Average Hours Watching Television or Videos	Average Hours Playing Computer Games	Average Hours Playing or Talking with Friends	Average Hours Doing Jobs at Home	Average Hours Playing Sports	Average Hours Reading a Book for Enjoyment
Australia	2.0 (0.05)	0.8 (0.02)	1.2 (0.03)	1.1 (0.02)	1.6 (0.03)	0.9 (0.02)
Austria	1.4 (0.04)	0.7 (0.03)	2.9 (0.06)	1.0 (0.04)	1.9 (0.05)	1.3 (0.05)
Canada	1.9 (0.04)	0.6 (0.02)	1.5 (0.04)	1.1 (0.03)	1.8 (0.03)	1.1 (0.03)
Cyprus	1.8 (0.05)	0.6 (0.03)	1.6 (0.05)	1.4 (0.04)	0.9 (0.04)	1.3 (0.04)
Czech Republic	1.7 (0.04)	0.6 (0.03)	2.4 (0.05)	1.2 (0.03)	1.6 (0.04)	1.0 (0.02)
England	2.2 (0.04)	1.2 (0.04)	1.5 (0.04)	0.9 (0.03)	1.7 (0.04)	1.0 (0.03)
Greece	1.3 (0.04)	0.7 (0.03)	1.2 (0.03)	1.3 (0.04)	1.8 (0.04)	1.6 (0.05)
Hong Kong	1.5 (0.04)	0.6 (0.03)	0.7 (0.03)	0.9 (0.02)	0.8 (0.02)	1.0 (0.02)
Hungary	2.3 (0.05)	0.9 (0.03)	1.9 (0.04)	1.8 (0.05)	1.7 (0.03)	1.3 (0.04)
Iceland	1.2 (0.04)	0.7 (0.03)	1.5 (0.06)	0.8 (0.04)	1.3 (0.04)	1.0 (0.03)
Iran, Islamic Rep.	r 1.3 (0.05)	0.3 (0.03)	r 1.1 (0.04)	r 1.7 (0.06)	r 1.2 (0.04)	r 1.3 (0.06)
Ireland	1.9 (0.05)	0.9 (0.04)	1.1 (0.04)	1.1 (0.03)	1.8 (0.04)	1.1 (0.03)
[2] *Israel*	r 2.5 (0.06)	r 1.1 (0.07)	r 1.8 (0.07)	r 1.3 (0.04)	r 2.1 (0.07)	r 1.4 (0.06)
Japan	1.9 (0.03)	0.8 (0.02)	1.4 (0.03)	0.8 (0.02)	1.3 (0.03)	0.9 (0.02)
Korea	1.5 (0.03)	0.3 (0.02)	1.0 (0.03)	0.7 (0.02)	0.7 (0.02)	1.0 (0.02)
Kuwait	1.4 (0.03)	1.1 (0.04)	1.0 (0.03)	1.4 (0.05)	1.7 (0.04)	1.3 (0.03)
[2] *Latvia (LSS)*	2.3 (0.07)	r 0.8 (0.06)	1.9 (0.06)	1.3 (0.05)	1.2 (0.05)	1.3 (0.05)
Netherlands	1.7 (0.06)	0.9 (0.03)	3.0 (0.06)	0.9 (0.03)	1.6 (0.05)	0.9 (0.03)
New Zealand	2.0 (0.06)	0.9 (0.04)	1.3 (0.04)	1.0 (0.03)	1.5 (0.04)	1.0 (0.03)
Norway	1.7 (0.04)	0.7 (0.03)	2.9 (0.05)	1.0 (0.03)	1.5 (0.04)	0.8 (0.03)
Portugal	1.5 (0.05)	0.7 (0.04)	1.2 (0.04)	0.9 (0.03)	1.4 (0.05)	1.1 (0.03)
Scotland	1.9 (0.06)	1.0 (0.04)	1.6 (0.05)	0.9 (0.03)	1.9 (0.04)	1.0 (0.03)
Singapore	- -	- -	- -	- -	- -	- -
Slovenia	1.5 (0.04)	0.7 (0.03)	1.2 (0.04)	1.7 (0.05)	1.8 (0.04)	1.3 (0.03)
Thailand	1.1 (0.09)	0.2 (0.02)	1.0 (0.06)	1.2 (0.03)	1.0 (0.03)	0.9 (0.03)
United States	2.0 (0.04)	0.8 (0.03)	1.5 (0.04)	1.2 (0.02)	2.0 (0.03)	1.2 (0.03)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours = 1.5; 3-4 hours = 3.5; More than 4 hours = 5.

[2] Modified response categories for Israel and Latvia: 3-5 hours = 4; More than 5 hours = 7.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

friends and one to two hours per school day playing sports. The time spent on leisure activities is not additive, because students often do these activities simultaneously (e.g., talk with friends and watch television). Nevertheless, it does appear that in most countries at least as much time is spent on some of these largely non-academic activities as on studying and doing mathematics homework.

Table 4.11 shows the relationship between mathematics achievement and the amount of time normally spent watching television on school days. Across the TIMSS countries, the highest mathematics achievement was associated with watching from one to two hours or even three to four hours of television per school day. Most commonly, fourth-grade students reported watching either less than one hour or from one to two hours of television on school days. That watching less than one hour of television per school day generally was associated with lower average mathematics achievement than watching one to two hours in many countries most likely has little to do with the influence of television viewing on mathematics achievement. For these students, low television viewing may be a surrogate socio-economic indicator, suggesting something about children's access to television sets across countries. Because students with fewer socio-economic advantages generally perform less well than their counterparts academically, it may be that students who reported less than one hour watching television each day simply do not have television sets in their homes, or come from homes with only one television set where they have less opportunity to spend a lot of time watching their choice of programming.

In nearly all countries, students watching more than four hours of television per day had the lowest average mathematics achievement. In about half the countries, 10% or more of the students reported watching more than four hours of television each day. The countries with 15% or more of such students included Australia (15%), England (18%), Hungary (20%), New Zealand (19%), and the United States (17%).

Table 4.11

Students' Reports on the Hours Spent Watching Television and Videos on a Normal School Day - Mathematics - Upper Grade (Fourth Grade*)

Country	Less than 1 Hour		1 to 2 Hours		3 to 4 Hours		More than 4 Hours	
Australia	32 (1.0)	547 (3.9)	36 (0.8)	555 (3.3)	17 (0.7)	555 (4.1)	15 (1.0)	520 (5.7)
Austria	41 (1.7)	554 (3.8)	43 (1.7)	568 (4.2)	9 (0.8)	573 (6.0)	7 (0.7)	534 (7.3)
Canada	36 (1.0)	533 (4.9)	37 (0.9)	548 (3.5)	14 (0.7)	532 (6.3)	13 (0.9)	510 (5.1)
Cyprus	34 (1.7)	504 (4.9)	41 (1.4)	512 (3.3)	15 (0.9)	504 (4.6)	10 (0.8)	483 (5.0)
Czech Republic	32 (1.4)	562 (4.7)	44 (1.3)	576 (3.5)	15 (0.8)	576 (4.0)	9 (0.8)	553 (4.6)
England	28 (1.3)	506 (5.3)	38 (1.0)	530 (3.9)	16 (0.9)	532 (4.9)	18 (0.9)	496 (4.1)
Greece	53 (1.4)	498 (4.0)	32 (1.5)	502 (4.0)	8 (0.7)	501 (8.9)	7 (0.6)	463 (9.9)
Hong Kong	48 (1.4)	586 (4.2)	31 (0.9)	597 (4.4)	12 (0.7)	589 (5.4)	9 (0.6)	563 (9.1)
Hungary	21 (1.2)	555 (5.4)	42 (1.2)	563 (4.4)	17 (0.8)	553 (4.9)	20 (1.2)	515 (4.6)
Iceland	53 (1.6)	478 (3.5)	33 (1.4)	479 (3.6)	9 (0.8)	481 (8.6)	5 (0.6)	455 (7.1)
Iran, Islamic Rep.	r 52 (2.1)	426 (3.8)	35 (1.7)	452 (5.6)	7 (0.7)	453 (6.4)	6 (0.7)	443 (10.2)
Ireland	33 (1.3)	538 (4.7)	37 (1.1)	565 (3.9)	16 (1.0)	566 (5.0)	14 (0.9)	538 (5.3)
† *Israel*	r 23 (1.3)	526 (5.7)	40 (1.3)	535 (3.7)	25 (1.2)	530 (5.1)	12 (0.9)	527 (6.2)
Japan	33 (0.8)	581 (2.9)	36 (0.9)	614 (2.5)	20 (0.6)	600 (3.0)	11 (0.6)	600 (4.6)
Korea	43 (1.0)	605 (2.6)	35 (0.9)	620 (2.9)	16 (0.8)	620 (3.5)	7 (0.5)	600 (7.0)
Kuwait	59 (1.1)	401 (2.8)	23 (1.0)	409 (3.2)	9 (0.5)	397 (4.5)	10 (0.5)	396 (3.5)
† *Latvia (LSS)*	32 (1.3)	514 (6.1)	37 (1.5)	549 (6.9)	19 (1.1)	534 (5.6)	12 (1.0)	503 (7.1)
Netherlands	36 (1.4)	579 (4.1)	39 (1.2)	583 (4.5)	15 (0.9)	592 (4.8)	9 (1.0)	553 (6.7)
New Zealand	36 (1.5)	503 (5.7)	31 (1.4)	520 (4.8)	15 (0.9)	507 (7.0)	19 (1.2)	463 (7.7)
Norway	33 (1.4)	493 (4.2)	46 (1.3)	512 (3.2)	14 (0.8)	521 (5.7)	8 (0.7)	503 (6.5)
Portugal	48 (1.8)	474 (4.3)	35 (1.5)	488 (4.0)	9 (0.7)	480 (6.6)	9 (0.9)	462 (6.5)
Scotland	37 (1.3)	518 (4.4)	36 (1.1)	532 (4.6)	13 (0.7)	527 (6.8)	14 (1.2)	502 (6.8)
Singapore	- -	- -	- -	- -	- -	- -	- -	- -
Slovenia	41 (1.6)	546 (4.4)	40 (1.3)	562 (3.9)	12 (0.9)	557 (5.9)	6 (0.7)	553 (7.7)
Thailand	65 (2.2)	488 (4.1)	23 (1.3)	500 (5.6)	5 (0.6)	500 (8.7)	6 (1.7)	457 (12.8)
United States	32 (0.9)	542 (3.2)	36 (0.7)	558 (3.5)	15 (0.8)	561 (3.9)	17 (0.7)	516 (3.0)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

† Modified response categories for Israel and Latvia: 3-5 hours; More than 5 hours.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

HOW DO STUDENTS PERCEIVE SUCCESS IN MATHEMATICS?

Table 4.12 presents fourth-grade students' perceptions about doing well in mathematics. In most countries, 85% or more of the students agreed or strongly agreed that they did well in mathematics. The exceptions, where more than 15% of the students disagreed or strongly disagreed about doing well, were Austria (17%), the Czech Republic (22%), Hong Kong (31%), Hungary (16%), Japan (27%), Latvia (LSS) (22%), Portugal (16%), Singapore (23%), and Thailand (21%). These countries represented a range in mathematics performance. Within countries, the pattern was much more consistent. Students who reported usually doing well in mathematics generally had higher achievement than students who reported doing less well. However, in several countries, most notably Norway, Scotland, and Thailand, the fourth graders who strongly agreed that they usually do well had lower average achievement than those who merely agreed.

Figure 4.1 indicates that, internationally, there was little difference between the genders in students' self-perceptions about how well they usually do in mathematics. This figure and the distributions shown in Table 4.12 also show that, on average, both boys and girls in the participating countries tended to agree about usually doing well in mathematics rather than report the extremes of strongly agreeing or disagreeing. For most countries both boys and girls tended to indicate that they did well in mathematics – a perception that did not always coincide with their achievement on the TIMSS mathematics test. However, fourth-grade girls had lower self-perceptions than boys in Austria, Hong Kong, Japan, the Netherlands, Singapore, and Slovenia. Hong Kong, Japan, and the Netherlands did show a significant difference in performance that favored boys at either the third or fourth grades. Considering their comparatively lower self-perceptions, it is interesting to note that fourth-grade Singaporean girls averaged 10 points higher on the TIMSS mathematics scale than did boys, though the difference was not statistically significant.

Table 4.12

Students' Self-Perceptions About Usually Doing Well in Mathematics Upper Grade (Fourth Grade*)

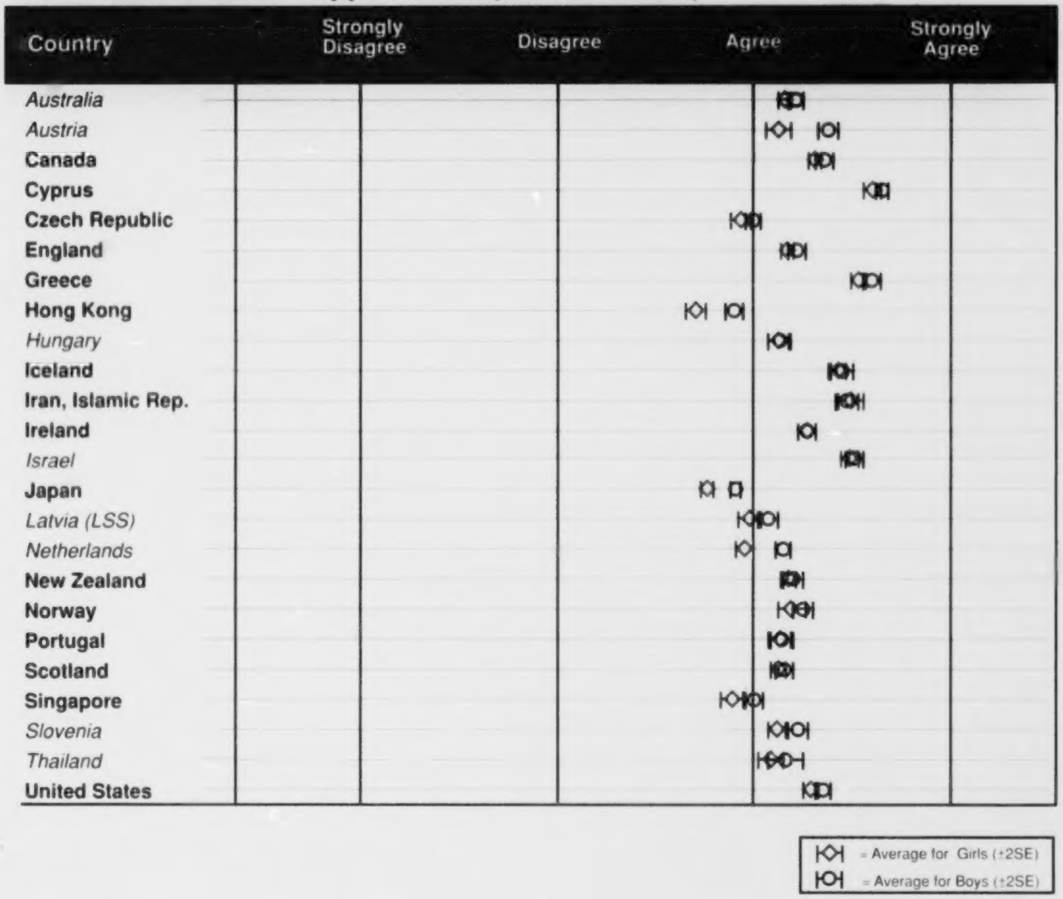
Country	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	3 (0.3)	462 (7.7)	7 (0.5)	489 (6.2)	59 (1.0)	545 (2.5)	31 (0.9)	578 (4.9)
Austria	3 (0.3)	476 (6.6)	14 (0.9)	509 (4.3)	39 (1.1)	548 (3.9)	44 (1.2)	591 (3.4)
Canada	2 (0.3)	~ ~	4 (0.4)	479 (7.9)	53 (1.3)	525 (3.8)	41 (1.3)	553 (4.0)
Cyprus	1 (0.2)	~ ~	2 (0.3)	~ ~	30 (1.1)	490 (3.7)	67 (1.2)	517 (3.5)
Czech Republic	3 (0.3)	490 (6.4)	19 (1.0)	521 (4.6)	58 (1.3)	580 (3.8)	20 (1.0)	590 (5.1)
England	3 (0.4)	457 (9.6)	7 (0.5)	486 (7.0)	57 (0.9)	517 (3.6)	33 (0.9)	521 (5.0)
Greece	1 (0.2)	~ ~	4 (0.4)	430 (8.9)	32 (1.4)	492 (4.4)	63 (1.4)	505 (3.9)
Hong Kong	6 (0.4)	515 (7.3)	25 (1.0)	571 (5.4)	53 (1.0)	598 (4.1)	17 (0.8)	603 (5.7)
Hungary	2 (0.3)	~ ~	14 (0.8)	506 (5.2)	53 (1.1)	546 (3.7)	31 (1.2)	581 (4.6)
Iceland	2 (0.3)	~ ~	5 (0.5)	441 (6.0)	42 (1.4)	472 (2.9)	51 (1.5)	485 (3.8)
Iran, Islamic Rep.	2 (0.3)	~ ~	3 (0.5)	405 (7.8)	40 (1.9)	435 (4.5)	55 (2.0)	435 (4.4)
Ireland	2 (0.2)	~ ~	5 (0.5)	498 (5.9)	57 (1.4)	553 (3.5)	36 (1.3)	559 (4.7)
Israel	r 3 (0.4)	531 (11.7)	5 (0.7)	528 (8.4)	31 (1.2)	530 (4.6)	61 (1.2)	538 (4.4)
Japan	3 (0.2)	495 (6.9)	24 (0.8)	545 (2.9)	62 (1.0)	609 (2.2)	12 (0.7)	661 (4.6)
Korea	- -	- -	- -	- -	- -	- -	- -	- -
Kuwait	5 (0.6)	405 (5.0)	6 (0.5)	381 (4.8)	33 (1.1)	396 (2.4)	56 (1.2)	408 (3.4)
Latvia (LSS)	2 (0.3)	~ ~	20 (1.3)	509 (10.9)	52 (1.5)	532 (4.8)	26 (1.2)	531 (5.6)
Netherlands	2 (0.4)	~ ~	13 (0.8)	547 (4.3)	61 (1.3)	580 (4.4)	24 (1.0)	601 (4.2)
New Zealand	3 (0.4)	426 (12.2)	8 (0.7)	465 (6.4)	56 (1.3)	500 (3.8)	32 (1.2)	517 (7.6)
Norway	3 (0.4)	454 (11.6)	7 (0.7)	493 (7.8)	56 (1.5)	510 (3.2)	35 (1.6)	503 (3.9)
Portugal	4 (0.4)	418 (7.9)	12 (1.0)	453 (5.7)	49 (1.2)	485 (3.4)	34 (1.3)	486 (5.0)
Scotland	2 (0.3)	~ ~	8 (0.6)	498 (6.8)	64 (1.3)	529 (3.8)	26 (1.2)	518 (6.0)
Singapore	4 (0.3)	502 (6.6)	19 (1.0)	571 (5.7)	55 (1.0)	637 (4.6)	22 (1.0)	673 (7.0)
Slovenia	1 (0.2)	~ ~	12 (0.8)	507 (4.7)	55 (1.1)	551 (3.8)	31 (1.2)	581 (5.7)
Thailand	3 (0.7)	448 (14.5)	18 (0.8)	467 (5.9)	41 (1.9)	500 (5.1)	37 (1.9)	491 (5.5)
United States	2 (0.2)	~ ~	7 (0.6)	501 (6.7)	47 (1.0)	541 (3.0)	44 (1.3)	564 (3.4)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 4.1

Gender Differences in Students' Self-Perceptions About Usually Doing Well in Mathematics - Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools.
Data are not available for Korea.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Students were asked about the necessity of various attributes or activities to do well in mathematics (see Table 4.13). There was some variation from country to country in the percentage of fourth-grade students agreeing that natural talent or ability were important to do well in mathematics. At the low end of the range, approximately 60% of the students agreed in the Czech Republic, Greece, and the United States. In comparison, 90% or more agreed in Hungary, Iran, Korea, Kuwait, and Norway.

The majority of students in about two-thirds of the countries were of the opinion that good luck was necessary to do well in mathematics. In only several countries did relatively few students agree that good luck was important to do well – Hong Kong (20%), the Netherlands (28%), and Singapore (36%). The countries where more than 70% of the fourth graders agreed that good luck was needed to do well in mathematics included Hungary, Iran, Kuwait, and Latvia (LSS).

Internationally, there was a high degree of agreement among students that a lot of hard work studying at home was necessary in order to do well in mathematics. Percentages of agreement were in the 80s and 90s for all countries except the Netherlands (77%) and Thailand (68%). There also was moderate consistency regarding students' agreement that it was necessary to memorize the textbook or notes. In about half the countries, more than 70% of the fourth-grade students agreed or strongly agreed that memorization was important to do well in mathematics. Ninety percent of the fourth graders agreed that memorization was important in Iceland, Iran, and Japan. In contrast, fewer than one-half of the fourth graders in the Netherlands (25%) and Slovenia (44%) agreed that memorization was important.

Table 4.13

Students' Reports on Things Necessary to Do Well in Mathematics Upper Grade (Fourth Grade*)

Country	Percent of Students Responding Agree or Strongly Agree			
	Natural Talent/Ability	Good Luck	Lots of Hard Work Studying at Home	Memorize the Textbook or Notes
Australia	85 (0.8)	59 (1.2)	84 (0.8)	68 (1.2)
Austria	72 (1.8)	54 (1.7)	83 (1.6)	58 (1.9)
Canada	81 (1.0)	49 (1.4)	90 (0.8)	62 (1.6)
Cyprus	68 (1.8)	58 (2.3)	96 (0.4)	71 (2.2)
Czech Republic	61 (1.5)	68 (1.3)	87 (0.8)	61 (1.9)
England	- -	- -	- -	- -
Greece	62 (1.4)	48 (1.7)	87 (1.0)	73 (1.8)
Hong Kong	74 (1.3)	20 (1.0)	95 (0.3)	62 (2.2)
Hungary	96 (0.4)	75 (1.1)	88 (0.7)	82 (1.0)
Iceland	79 (1.4)	63 (1.6)	90 (0.9)	92 (0.8)
Iran, Islamic Rep.	r 96 (0.6)	r 74 (2.4)	r 94 (0.6)	r 90 (1.0)
Ireland	87 (1.0)	65 (1.4)	91 (0.7)	72 (1.4)
Israel	r 66 (1.6)	r 43 (1.8)	r 96 (0.5)	r 67 (1.8)
Japan	79 (0.9)	53 (1.2)	91 (0.5)	93 (0.5)
Korea	90 (0.6)	62 (1.1)	95 (0.5)	84 (0.9)
Kuwait	92 (0.6)	76 (1.5)	87 (0.8)	89 (0.9)
Latvia (LSS)	77 (1.3)	86 (1.0)	92 (0.7)	60 (2.2)
Netherlands	64 (1.6)	28 (1.7)	77 (1.6)	25 (2.2)
New Zealand	84 (1.1)	64 (1.4)	87 (0.9)	73 (1.4)
Norway	93 (0.5)	58 (1.6)	89 (0.9)	81 (1.0)
Portugal	86 (1.2)	66 (2.1)	95 (0.5)	80 (1.7)
Scotland	- -	- -	- -	- -
Singapore	88 (0.7)	36 (1.5)	95 (0.5)	60 (2.0)
Slovenia	84 (1.2)	63 (2.1)	92 (0.8)	44 (2.0)
Thailand	78 (1.2)	65 (2.0)	68 (2.3)	87 (1.0)
United States	62 (1.0)	46 (1.2)	93 (0.4)	69 (1.0)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

( ) Standard errors appear in parentheses.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE STUDENTS' ATTITUDES TOWARDS MATHEMATICS?

To collect information on fourth-grade students' perceptions of mathematics, TIMSS asked them several questions about its importance and enjoyability. Students' perceptions about the value of learning mathematics may be considered as both an input and outcome variable, because their attitudes toward the subject can be related to educational achievement in ways that reinforce higher or lower performance. That is, students who do well in mathematics generally have more positive attitudes toward the subject, and those who have more positive attitudes tend to perform better.

Table 4.14 provides students' responses to the question about how much they like or dislike mathematics. In more than a third of the countries, a positive relationship was observed between a stronger liking of mathematics and higher achievement. Even though the pattern was not uniform across countries, students who reported either liking mathematics or liking it a lot generally had higher achievement than students who reported disliking it to some degree. The overwhelming majority of fourth-graders in every country indicated they liked mathematics to some degree, but not all students felt positive about this subject area. In Japan, Korea, and the Netherlands, more than one-quarter of the fourth-grade students reported disliking mathematics.

The data in Figure 4.2 reveal that, on average, fourth graders of both genders were relatively positive about liking mathematics. In Austria, Hong Kong, Japan, and the Netherlands boys reported a significantly stronger liking of the subject area than did girls. However, girls reported liking mathematics better than boys did in Ireland and Scotland. As a point of comparison, these patterns generally held at the eighth grade. The countries where eighth-grade boys reported liking mathematics better than girls also included Norway, but the differences in Ireland and Scotland favoring girls were no longer significant.

Table 4.14

Students' Reports on How Much They Like Mathematics Upper Grade (Fourth Grade*)

Country	Dislike a Lot		Dislike		Like		Like a Lot	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	7 (0.6)	501 (6.0)	10 (0.6)	547 (5.1)	42 (0.8)	547 (3.5)	41 (1.1)	561 (4.2)
Austria	10 (0.9)	532 (5.4)	14 (0.8)	548 (6.7)	32 (1.1)	556 (3.9)	44 (1.1)	574 (4.1)
Canada	5 (0.4)	511 (5.8)	6 (0.4)	535 (6.6)	39 (1.2)	531 (4.1)	50 (1.2)	538 (3.7)
Cyprus	2 (0.3)	~ ~	3 (0.4)	482 (8.6)	22 (1.2)	499 (4.0)	73 (1.4)	510 (3.2)
Czech Republic	4 (0.5)	534 (7.6)	13 (0.9)	552 (6.9)	48 (1.0)	571 (3.9)	36 (1.3)	573 (3.9)
England	7 (0.7)	498 (5.9)	9 (0.6)	516 (7.8)	32 (1.0)	519 (3.9)	52 (1.3)	512 (4.2)
Greece	2 (0.3)	~ ~	4 (0.5)	475 (11.1)	23 (0.9)	487 (4.0)	71 (1.2)	502 (4.4)
Hong Kong	6 (0.5)	551 (8.0)	13 (0.8)	572 (6.6)	46 (1.8)	592 (4.6)	36 (2.1)	595 (5.0)
Hungary	6 (0.6)	520 (7.6)	10 (0.8)	536 (5.9)	47 (1.3)	546 (4.3)	37 (1.5)	563 (4.7)
Iceland	3 (0.6)	445 (7.6)	4 (0.6)	458 (9.0)	30 (1.5)	466 (3.4)	63 (1.8)	484 (3.6)
Iran, Islamic Rep.	1 (0.3)	~ ~	2 (0.3)	~ ~	18 (1.3)	438 (5.1)	79 (1.5)	433 (4.4)
Ireland	8 (0.7)	528 (7.0)	8 (0.6)	543 (6.8)	33 (1.1)	555 (4.0)	50 (1.3)	555 (4.1)
Israel	r 7 (0.7)	535 (7.1)	11 (1.0)	542 (7.5)	33 (1.6)	528 (5.2)	50 (2.1)	534 (4.1)
Japan	6 (0.4)	539 (5.4)	22 (0.8)	574 (2.9)	47 (0.9)	598 (2.1)	24 (1.0)	633 (3.8)
Korea	6 (0.5)	572 (7.2)	21 (0.8)	593 (3.5)	40 (0.9)	614 (2.4)	33 (0.9)	629 (2.9)
Kuwait	3 (0.3)	378 (6.3)	3 (0.4)	391 (6.6)	18 (0.8)	395 (2.9)	76 (1.2)	405 (3.1)
Latvia (LSS)	7 (0.8)	481 (10.0)	11 (0.8)	515 (8.7)	45 (1.4)	528 (6.0)	37 (1.4)	537 (4.7)
Netherlands	9 (0.9)	567 (6.1)	26 (1.1)	571 (4.0)	37 (1.3)	585 (4.1)	27 (1.1)	586 (4.4)
New Zealand	10 (0.8)	475 (7.2)	9 (0.6)	494 (7.9)	35 (1.3)	505 (4.4)	46 (1.6)	504 (6.1)
Norway	9 (0.9)	500 (5.3)	14 (1.1)	513 (6.5)	37 (1.3)	511 (3.0)	40 (1.7)	498 (3.7)
Portugal	2 (0.3)	~ ~	6 (0.6)	453 (5.3)	36 (1.3)	475 (3.1)	55 (1.5)	483 (4.3)
Scotland	8 (0.6)	501 (7.8)	9 (0.6)	534 (6.5)	33 (1.1)	535 (4.5)	51 (1.3)	516 (4.6)
Singapore	2 (0.2)	~ ~	5 (0.4)	565 (8.4)	40 (0.9)	610 (5.8)	52 (1.0)	648 (5.0)
Slovenia	3 (0.5)	560 (13.7)	8 (0.6)	534 (5.9)	40 (1.3)	550 (4.2)	49 (1.7)	558 (4.0)
Thailand	2 (0.5)	~ ~	7 (0.7)	464 (8.4)	37 (1.6)	488 (5.4)	55 (1.8)	494 (5.0)
United States	8 (0.5)	513 (4.2)	8 (0.5)	535 (4.7)	34 (1.2)	549 (3.6)	50 (1.6)	550 (3.9)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

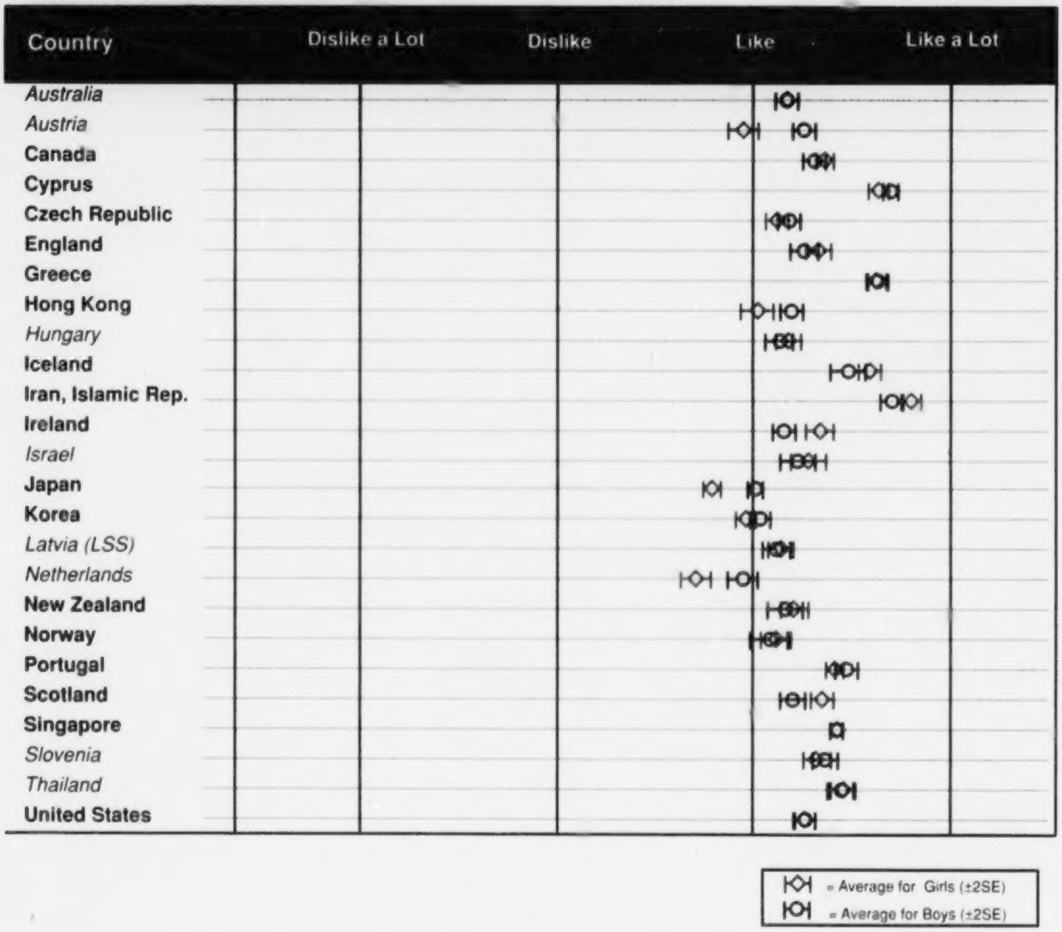
A tilde (~) indicates insufficient data to report achievement.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 4.2

Gender Differences in Liking Mathematics Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

To gain some understanding of fourth graders' enjoyment of mathematics as a school subject, TIMSS asked students to state their level of agreement with the following two statements: 1) Mathematics is boring, and 2) I enjoy learning mathematics. The results for these two questions were combined with students' responses to the question about liking mathematics to form an index of their overall attitudes toward mathematics based on all three questions.

The data for the index in Table 4.15 reveal that fourth-grade students generally had positive attitudes toward mathematics, and that those students with more positive attitudes had higher average mathematics achievement. On average, across the three questions comprising the mathematics attitude index, the majority of students in each TIMSS country expressed positive or strongly positive attitudes about mathematics. Few students (usually 5% or less) consistently had strongly negative opinions about all three aspects of the enjoyability of the subject, and less than one-fourth expressed any type of negative feelings.

Gender differences for the index of overall liking and enjoyability of mathematics are portrayed in Figure 4.3. In many countries, girls and boys reported similarly positive overall attitudes towards mathematics. The countries where boys' attitudes were significantly more positive than those of girls included Austria, Hong Kong, Japan, and the Netherlands. In Ireland, girls had more positive overall attitudes towards mathematics than did boys.

Table 4.15

Students' Overall Attitudes[1] Towards Mathematics Upper Grade (Fourth Grade*)

Country	Strongly Negative		Negative		Positive		Strongly Positive	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	5 (0.5)	513 (6.1)	14 (0.7)	531 (4.7)	44 (0.9)	543 (3.6)	37 (1.1)	567 (4.4)
Austria	6 (0.7)	548 (5.8)	19 (1.0)	537 (4.7)	36 (1.2)	559 (3.9)	39 (1.5)	574 (4.5)
Canada	3 (0.4)	522 (8.4)	10 (0.7)	522 (5.1)	41 (1.2)	524 (4.2)	46 (1.1)	544 (3.5)
Cyprus	1 (0.2)	~ ~	4 (0.4)	475 (6.9)	34 (1.0)	480 (3.8)	61 (1.2)	522 (3.0)
Czech Republic	2 (0.3)	~ ~	16 (0.9)	553 (5.3)	55 (1.0)	565 (3.7)	26 (1.2)	583 (4.4)
England	5 (0.5)	510 (7.3)	13 (0.8)	505 (6.2)	32 (1.1)	509 (4.3)	50 (1.5)	518 (3.9)
Greece	1 (0.2)	~ ~	5 (0.5)	463 (10.5)	28 (0.9)	471 (4.4)	66 (1.2)	509 (4.0)
Hong Kong	3 (0.4)	580 (9.0)	16 (0.8)	566 (6.4)	52 (1.5)	585 (4.5)	29 (1.8)	603 (5.3)
Hungary	4 (0.5)	538 (7.6)	17 (1.2)	536 (5.7)	49 (1.1)	538 (3.8)	30 (1.2)	577 (5.2)
Iceland	3 (0.6)	459 (9.9)	7 (0.6)	459 (5.5)	31 (1.5)	461 (3.9)	59 (1.6)	487 (3.6)
Iran, Islamic Rep.	1 (0.2)	~ ~	5 (0.6)	425 (5.9)	48 (1.7)	418 (3.9)	47 (1.9)	447 (4.8)
Ireland	5 (0.6)	542 (6.5)	15 (0.8)	542 (4.4)	39 (1.0)	546 (4.5)	41 (1.2)	560 (3.9)
Israel	r 5 (0.7)	540 (7.6)	13 (1.0)	538 (7.8)	39 (1.3)	526 (3.9)	43 (1.8)	539 (4.7)
Japan	3 (0.3)	547 (6.8)	22 (0.9)	570 (3.3)	56 (1.0)	598 (2.3)	18 (0.8)	636 (3.8)
Korea	4 (0.4)	588 (8.5)	24 (0.9)	591 (3.1)	43 (0.9)	610 (2.6)	29 (0.9)	633 (2.7)
Kuwait	1 (0.2)	~ ~	6 (0.4)	381 (4.8)	40 (1.2)	383 (2.7)	53 (1.3)	418 (2.9)
Latvia (LSS)	2 (0.4)	~ ~	16 (1.0)	509 (8.5)	52 (1.2)	526 (5.8)	30 (1.2)	538 (4.1)
Netherlands	8 (0.8)	569 (6.9)	24 (1.1)	570 (4.3)	41 (1.4)	581 (4.3)	27 (1.2)	590 (4.1)
New Zealand	5 (0.6)	498 (7.1)	15 (0.8)	479 (5.7)	41 (1.1)	493 (5.0)	40 (1.3)	515 (5.8)
Norway	5 (0.6)	507 (7.8)	17 (1.2)	509 (5.0)	39 (1.3)	503 (3.4)	40 (1.7)	504 (3.5)
Portugal	1 (0.1)	~ ~	7 (0.6)	448 (7.2)	42 (1.2)	457 (4.2)	51 (1.4)	498 (3.3)
Scotland	- -	- -	- -	- -	- -	- -	- -	- -
Singapore	1 (0.1)	~ ~	7 (0.5)	565 (8.4)	43 (0.8)	605 (5.5)	49 (1.0)	652 (5.2)
Slovenia	2 (0.4)	~ ~	12 (0.9)	539 (5.7)	46 (1.3)	543 (4.5)	40 (1.5)	567 (3.6)
Thailand	0 (0.1)	~ ~	10 (1.2)	445 (7.9)	62 (1.5)	487 (4.4)	28 (1.8)	509 (4.6)
United States	5 (0.4)	527 (7.4)	14 (0.7)	527 (4.0)	37 (1.1)	542 (3.9)	44 (1.5)	556 (3.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Index of overall attitudes towards mathematics is based on average of responses to the following statements:

1) I like mathematics; 2) I enjoy learning mathematics; 3) Mathematics is boring (reversed scale);

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

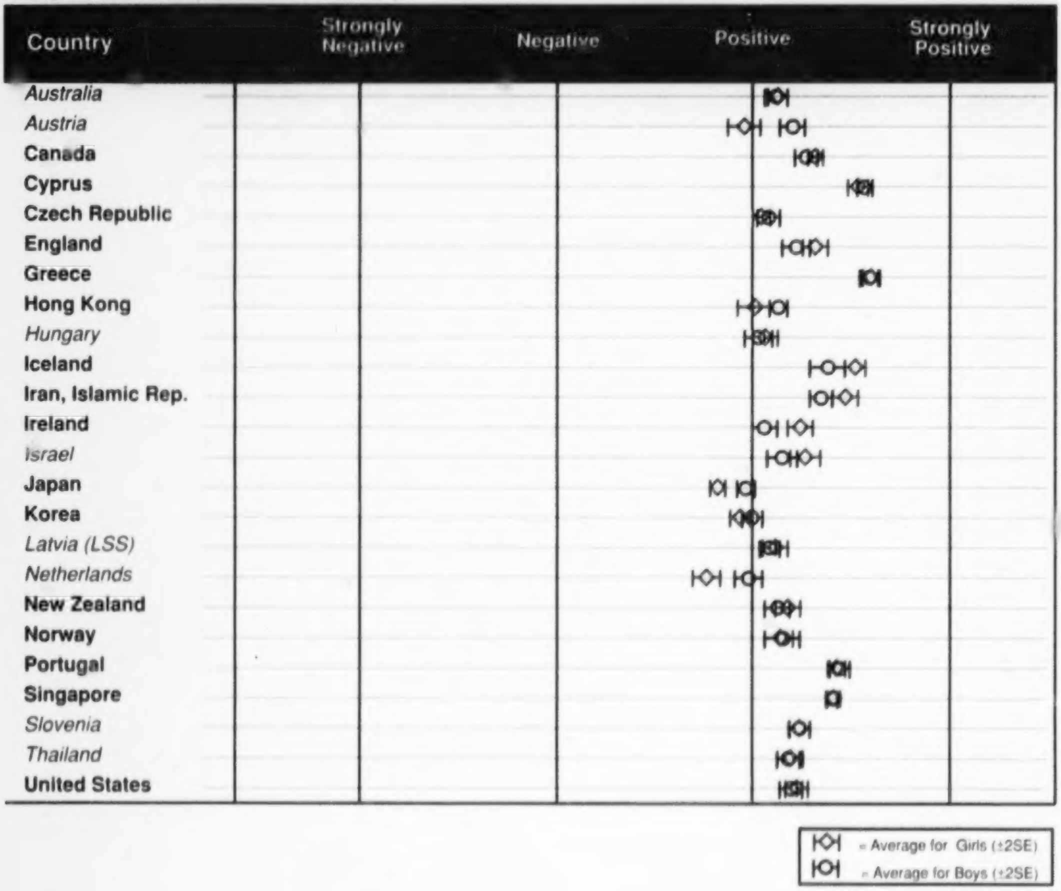
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 4.3

Gender Differences in Students' Overall Attitudes[1] Towards Mathematics Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Index of overall attitudes towards mathematics is based on average of responses to the following statements:
1) I like mathematics; 2) I enjoy learning mathematics; 3) Mathematics is boring (reversed scale).

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Data are not available for Scotland.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

BEST COPY AVAILABLE

Chapter 5

TEACHERS AND INSTRUCTION

Teachers and the instructional approaches they use are fundamental in building students' mathematical understanding. Primary among their many duties and responsibilities, teachers structure and guide the pace of individual, small-group, and whole-class work to present new material, engage students in mathematical tasks, and help deepen students' grasp of the mathematics being studied. Teachers may help students use technology and tools to investigate mathematical ideas, analyze students' work for misconceptions, and promote positive attitudes towards mathematics. They also may assign homework and conduct informal as well as formal assessments to monitor progress in student learning, make ongoing instructional decisions, and evaluate achievement outcomes.

Effective teaching is a complex endeavor requiring knowledge about the subject matter of mathematics and the ways students learn, as well as familiarity with a variety of pedagogical approaches in mathematics. It can be fostered through institutional support and adequate resources. Teachers also can support each other in planning instructional strategies, devising real-world applications of mathematical concepts, and developing sequences that move students from concrete tasks to the ability to think for themselves and explore mathematical theories.

TIMSS administered a background questionnaire to teachers to gather information about their backgrounds and training, and how they think about mathematics. The questionnaire also asked about how they spend their school-related time and the instructional approaches they use in their classrooms. Information was collected about the materials used in instruction, the activities students do in class, the use of calculators and computers in mathematics lessons, and the role of homework.

This chapter presents the results of teachers' responses to some of these questions. Because the sampling for the teacher questionnaires was based on participating students, the responses to the mathematics teacher questionnaire do not necessarily represent all of the fourth-grade mathematics teachers in each of the TIMSS countries. Rather, they represent teachers of the representative samples of students assessed. It is important to note that in this report, the student is always the unit of analysis, even when information from the teachers' questionnaires is being reported. Using the student as the unit of analysis makes it possible to describe the instruction received by representative samples of students. Although this approach may provide a different perspective from that obtained by simply collecting information from teachers, it is consistent with the TIMSS goals of providing information about the educational contexts and performance of students.

In the primary grades, students generally are taught both mathematics and science by a single classroom teacher who provides instruction in all subjects. Accordingly, the international version of the teacher questionnaire for the primary grades was prepared as a single document asking about demographic information and instruction in both mathematics and science. However, in some countries, a portion or even all of the students are taught mathematics and science by different teachers, and it was difficult to make provisions for both teachers to complete the questionnaire. Also, because countries were required to sample two classes (from adjacent grades), it was possible for an individual to be the mathematics and/or science teacher of both the upper- and lower-grade classes. In order to keep the response burden for teachers to a minimum, no teacher was asked to respond to more than one questionnaire, even where that teacher taught mathematics and/or science to more than one of the sampled classes. These situations, together with the fact that teachers sometimes did not complete the questionnaire assigned to them, meant that each country had some percentage of students for whom no teacher questionnaire information was available. The tables in this chapter contain special notation regarding the availability of teacher responses. For a country where teacher responses were available for 70% to 84% of the students, an "r" is included next to the data for that country. When teacher responses were available for 50% to 69% of the students, an "s" is included next to the data for that country. When teacher responses were available for less than 50% of the students, an "x" replaces the data.

WHO DELIVERS MATHEMATICS INSTRUCTION?

This section provides information about the mathematics teaching force in each of the participating countries, in terms of certification, degrees, age, gender, and years of teaching experience.

Table 5.1 summarizes information gathered from each country about the requirements for the certification held by the majority of the third- and fourth-grade teachers. In some countries, the type of education required for qualification includes a university degree. In other countries, study at a teacher training institution is required, or even both a university degree and study at a teacher training institution. The number of years of post-secondary education required for a teaching qualification ranged from two years in Iran, Hong Kong, and Singapore to as much as six years in Canada, although many countries reported three or four years. All of the countries except Greece and Kuwait reported that teaching practice was required. A large number of countries reported that an evaluation or examination was required for certification. The countries not having such a requirement were Canada, Greece, Iran, Israel, Korea, Portugal, and the United States.

Table 5.2 summarizes teachers' reports on their age and gender. If a constant supply of teachers were entering the teaching force, devoting their careers to the classroom, and then retiring, one might expect approximately equal percentages of students taught by teachers in their 20s, 30s, 40s, and 50s. However, this does not appear to hold for most countries. In most countries, the majority of the fourth-grade students were taught

Table 5.1

Requirements for Certification Held by the Majority of Lower- and Upper-Grade (Third and Fourth Grade*) Teachers[1]

Country	Type of Education Required for Qualification	Number of Years of Post Secondary Education Required	Teaching or Practice Experience Required	Evaluation or Examination Required
Australia	**University or Teacher Training Institution**	**3–4**	**yes**	**yes**
Austria	Teacher Training Institution	3	yes	yes
Canada	University	4–6	yes	no
Cyprus	Teacher Training Institution	3	yes	yes
Czech Republic	University	4	yes	yes
[2] England	University or Higher Education Institution	3–5	yes	yes
[3] Greece	Post-Secondary Non-University Teacher Training Institution	4	no	no
Hong Kong	Teacher Training Institution	2 or 3	yes	yes
Hungary	Teacher Training Institution	3	yes	yes
Iceland	University	3	yes	yes
Iran	Teacher Training Institution	2	yes	no
Ireland	University College	3	yes	yes
Israel	Teacher Training Institution	3	yes	no
Japan	University	4	yes	yes
Korea	University	4	yes	no
Kuwait	University	4	no	yes
Latvia	Teacher Training Institution	3	yes	yes
Netherlands	Teacher Training Institution	3[4]	yes	yes
New Zealand	Teacher Training Institution	3	yes	yes
Norway	Teacher Training Institution	3[5]	yes	yes
Portugal	Teacher Training Institution	3[6]	yes	no
Scotland	University or Teacher Training Institution	4	yes	yes
Singapore	Teacher Training Institution	2	yes	yes
Slovenia	University	4	yes	yes
Thailand	University or Teacher Training Institution	4	yes	yes
[7] United States	University	4	yes	no

*Third and fourth grades in most countries; see Table 2 for more information about the grades tested in each country.

[1] Certification pertains to the majority (more than 50%) of teachers of lower- and upper-grade students in each country.

[2] England: The majority of teachers of primary schools students will have studied education and their specialist subject concurrently for 4 years (B. Ed with honors) or 3 years (B. Ed without honors). Some, however, will have studied their specialist subject for a degree (B. Sc. or B.A.) for 3 or 4 years followed by a one-year post graduate course. All teachers who qualified since 1975 are graduates. Some teachers who qualified before this date hold teachers' certificates but are not graduates.

[3] Greece: The vast majority of primary school teachers are Post-Secondary Non-University Teacher Training Institute graduates (last graduates 1990). Only a small fraction of existing teachers are graduates of the newly founded University Education Departments (first graduates 1989).

[4] Netherlands: As of August 1984 a 4-year teacher training program integrating training for kindergarten and primary education is required. Before August 1994, 3 years of teacher training were required for primary education.

[5] Norway: Until 1965 2 years of post-secondary education were required. Between 1965 and 1995 3 years were required. As of 1996, new certified teachers are required to have completed 4 years of post-secondary education.

[6] Portugal: Until 1986 2 years of post-secondary education were required. As of 1986 3 years are required.

[7] United States: Certification requirements vary considerably according to state in the United States. Information in this table represents the most typical requirements across states.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Table 5.2

Teachers' Reports on Their Age and Gender Mathematics - Upper Grade (Fourth Grade*)

Country	Percent of Students Taught by Teachers				Percent of Students Taught by Teachers	
	29 Years or Under	30 - 39 Years	40 - 49 Years	50 Years or Older	Female	Male
Australia	21 (3.0)	31 (3.3)	36 (3.3)	12 (2.2)	65 (4.0)	35 (4.0)
Austria	10 (2.6)	29 (4.6)	47 (5.0)	15 (3.4)	78 (4.3)	22 (4.3)
Canada	8 (1.8)	22 (3.4)	44 (3.3)	26 (2.7)	80 (3.1)	20 (3.1)
Cyprus	s 40 (5.8)	12 (3.1)	29 (5.1)	19 (4.4)	s 69 (5.1)	31 (5.1)
Czech Republic	13 (2.8)	23 (3.4)	20 (3.0)	45 (3.8)	94 (1.8)	6 (1.8)
England	16 (3.5)	19 (4.1)	49 (5.1)	16 (3.3)	75 (3.2)	25 (3.2)
Greece	12 (2.8)	41 (4.3)	33 (4.1)	14 (2.9)	49 (4.6)	51 (4.6)
Hong Kong	34 (4.9)	25 (5.3)	18 (3.3)	23 (4.5)	66 (4.3)	34 (4.3)
Hungary	9 (2.4)	41 (4.6)	31 (4.0)	19 (3.6)	91 (2.3)	9 (2.3)
Iceland	11 (2.2)	35 (5.3)	44 (5.1)	11 (2.5)	83 (3.9)	17 (3.9)
Iran, Islamic Rep.	42 (4.2)	43 (4.5)	14 (2.8)	1 (0.8)	54 (4.3)	46 (4.3)
Ireland	17 (3.3)	31 (4.1)	31 (4.5)	22 (4.1)	69 (3.9)	31 (3.9)
Israel	s 13 (4.8)	40 (7.6)	35 (7.3)	13 (4.2)	s 98 (2.1)	2 (2.1)
Japan	12 (2.7)	40 (4.1)	38 (4.5)	11 (2.3)	61 (3.9)	39 (3.9)
Korea	22 (3.2)	29 (3.0)	33 (3.9)	16 (2.8)	64 (3.8)	36 (3.8)
Kuwait	r 33 (4.5)	53 (5.0)	11 (3.0)	3 (1.6)	r 54 (2.7)	46 (2.7)
Latvia (LSS)	21 (4.3)	35 (4.4)	21 (4.1)	23 (4.0)	97 (1.4)	3 (1.4)
Netherlands	17 (3.3)	29 (4.1)	40 (4.6)	14 (3.4)	35 (4.3)	65 (4.3)
New Zealand	21 (3.4)	28 (3.5)	37 (4.2)	14 (2.4)	68 (3.5)	32 (3.5)
Norway	6 (2.1)	15 (3.4)	44 (4.6)	35 (4.7)	78 (3.6)	22 (3.6)
Portugal	6 (2.3)	21 (3.5)	48 (4.2)	25 (3.8)	95 (1.9)	5 (1.9)
Scotland	19 (3.1)	21 (3.6)	40 (4.6)	19 (3.4)	92 (2.1)	8 (2.1)
Singapore	34 (3.7)	16 (2.3)	33 (3.6)	17 (2.5)	82 (3.2)	18 (3.2)
Slovenia	12 (3.1)	34 (4.9)	30 (4.5)	24 (4.6)	92 (2.6)	8 (2.6)
Thailand	4 (2.3)	50 (5.3)	35 (5.0)	11 (3.5)	55 (6.1)	45 (6.1)
United States	16 (2.8)	23 (2.7)	37 (4.3)	24 (4.0)	86 (2.5)	14 (2.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

by teachers in their 30s or 40s. Very few countries seemed to have a comparatively younger teaching force, but those that did included Iran and Kuwait, in particular. In these two countries, 80% or more of the students had mathematics teachers in their 30s or younger. According to teachers' reports, the teaching force in fourth-grade mathematics also was comparatively older in a few countries. The TIMSS participants where 65% or more of the fourth-grade students had mathematics teachers in their 40s or older included the Czech Republic, England, and Norway.

In several countries, approximately equivalent percentages of fourth-grade students were taught mathematics by male teachers and female teachers, including Greece, Iran, Kuwait, and Thailand. However, in most countries the teaching force was predominantly female. Ninety percent or more of the fourth-grade students had female mathematics teachers in the Czech Republic, Hungary, Israel, Latvia (LSS), Portugal, Scotland, and Slovenia. In contrast, 65% of the students had male teachers in the Netherlands.

As might be expected from the differences in teachers' ages from country to country, the TIMSS data indicate differences in teachers' longevity across countries (see Table 5.3). The countries with younger teaching forces tended to have more students taught by less experienced teachers. At least half the fourth-grade students in Cyprus, Iceland, Iran, and Kuwait had mathematics teachers with 10 years or less of experience. In contrast, at least half the students in the Czech Republic and Portugal had mathematics teachers with more than 20 years of experience.

The relationship between years of teaching experience and mathematics achievement was not consistent across countries. In more than half the countries, there was essentially no difference in students' performance in relation to years of teaching experience. In about one-fourth of the countries, the fourth-grade students with the most experienced teachers (more than 20 years) had higher mathematics achievement than did those with less experienced teachers (five years or less). This may reflect the practice of giving teachers with more seniority the more advanced classes. However, in Hong Kong and Singapore, the pattern of higher student performance for the more experienced teachers was reversed. For the remaining countries, there were inconsistent patterns of performance differences in relation to years of teaching experience.

Table 5.3

Teachers' Reports on Their Years of Teaching Experience Mathematics - Upper Grade (Fourth Grade*)

Country	0 - 5 Years		6-10 Years		11-20 Years		More than 20 Years	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	r 15 (2.4)	553 (7.9)	23 (3.1)	546 (6.5)	38 (3.5)	546 (6.0)	25 (3.4)	543 (7.4)
Austria	10 (2.7)	564 (9.3)	11 (3.3)	566 (7.2)	31 (4.1)	551 (7.7)	47 (4.9)	564 (4.5)
Canada	11 (1.8)	507 (10.6)	18 (2.9)	537 (8.4)	24 (2.8)	533 (5.4)	47 (3.5)	536 (5.5)
Cyprus	s 37 (5.5)	501 (7.0)	13 (4.0)	505 (10.7)	11 (2.7)	498 (12.8)	39 (5.6)	515 (8.1)
Czech Republic	16 (2.7)	553 (6.5)	8 (2.3)	544 (8.7)	20 (2.8)	570 (7.1)	55 (4.1)	574 (4.9)
England	19 (3.5)	504 (6.8)	14 (3.4)	513 (11.2)	34 (4.4)	513 (7.6)	33 (4.4)	521 (7.5)
Greece	11 (2.5)	493 (17.9)	22 (3.3)	495 (6.2)	31 (4.1)	492 (7.4)	36 (4.0)	500 (7.7)
Hong Kong	26 (4.4)	598 (9.4)	14 (3.0)	597 (8.5)	26 (4.9)	586 (7.3)	34 (5.1)	579 (7.9)
Hungary	8 (2.6)	550 (15.1)	12 (2.9)	538 (12.3)	42 (4.7)	547 (4.9)	38 (4.7)	554 (6.4)
Iceland	23 (4.3)	470 (3.2)	24 (5.1)	471 (6.5)	31 (5.3)	488 (5.8)	21 (4.1)	468 (4.7)
Iran, Islamic Rep.	33 (4.1)	416 (9.7)	19 (3.9)	427 (7.2)	40 (4.6)	435 (7.4)	8 (2.6)	456 (9.8)
Ireland	10 (2.9)	537 (19.1)	14 (3.4)	533 (8.7)	32 (4.1)	548 (5.1)	44 (4.6)	560 (5.3)
Israel	s 18 (5.1)	535 (9.2)	13 (5.0)	510 (14.2)	35 (7.2)	532 (5.9)	34 (7.5)	538 (7.5)
Japan	11 (2.8)	589 (7.5)	10 (2.5)	585 (5.5)	57 (3.6)	601 (2.8)	22 (3.0)	596 (4.0)
Korea	12 (2.6)	608 (7.4)	23 (3.4)	611 (4.2)	27 (3.5)	612 (4.8)	38 (3.8)	611 (4.1)
Kuwait	r 30 (4.6)	397 (6.7)	35 (5.1)	397 (5.1)	28 (4.5)	411 (3.9)	7 (2.7)	398 (12.5)
Latvia (LSS)	13 (3.4)	509 (13.2)	18 (3.6)	514 (9.0)	33 (4.7)	523 (8.2)	36 (4.8)	537 (8.9)
Netherlands	14 (2.5)	568 (9.3)	11 (2.9)	564 (8.9)	39 (3.9)	582 (4.2)	36 (4.8)	581 (6.6)
New Zealand	23 (3.8)	491 (9.9)	16 (3.0)	505 (8.9)	38 (4.5)	496 (8.0)	23 (3.4)	513 (7.1)
Norway	11 (3.0)	517 (7.7)	10 (3.2)	492 (9.2)	32 (4.3)	498 (4.4)	47 (5.7)	502 (5.0)
Portugal	6 (2.0)	440 (20.9)	9 (2.0)	461 (8.9)	15 (3.0)	471 (8.0)	70 (3.9)	481 (4.6)
Scotland	25 (3.8)	511 (8.8)	19 (3.3)	535 (9.0)	33 (4.3)	517 (9.3)	23 (3.9)	529 (8.9)
Singapore	30 (3.8)	640 (10.2)	9 (2.6)	625 (19.9)	14 (2.7)	637 (17.3)	48 (3.6)	615 (6.7)
Slovenia	10 (2.7)	553 (12.0)	14 (3.5)	553 (9.3)	32 (4.9)	549 (6.1)	44 (4.9)	550 (5.2)
Thailand	r 25 (4.4)	463 (8.3)	16 (4.2)	503 (14.9)	39 (5.3)	482 (7.6)	19 (3.9)	522 (10.8)
United States	21 (2.9)	537 (5.5)	18 (3.0)	557 (6.4)	29 (2.4)	556 (6.0)	32 (3.0)	546 (5.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT ARE TEACHERS' PERCEPTIONS ABOUT MATHEMATICS?

Figure 5.1 depicts the percentages of fourth-grade students whose mathematics teachers reported certain beliefs about mathematics and the way mathematics should be taught. Teachers in many countries indicated a fairly practical view of mathematics, seeing it essentially as a way of modeling the real world. However, there was variation across countries in the amount of agreement with this view of the nature of mathematics. In Thailand, nearly all students had teachers who agreed or strongly agreed that mathematics is primarily a formal way of representing the real world, while in several countries (the Czech Republic, Slovenia, the Netherlands, Iceland, and Hungary), about 40% or fewer of the students had mathematics teachers who agreed with this view.

There also appeared to be nearly uniform agreement by teachers across countries about the inherent nature of mathematical abilities. In most countries, 80% or more of the students had teachers who agreed that some students have a natural talent for mathematics. However, again there was some variation. For example, only about 60% or so of the students in Korea and Hong Kong had teachers that agreed with this premise.

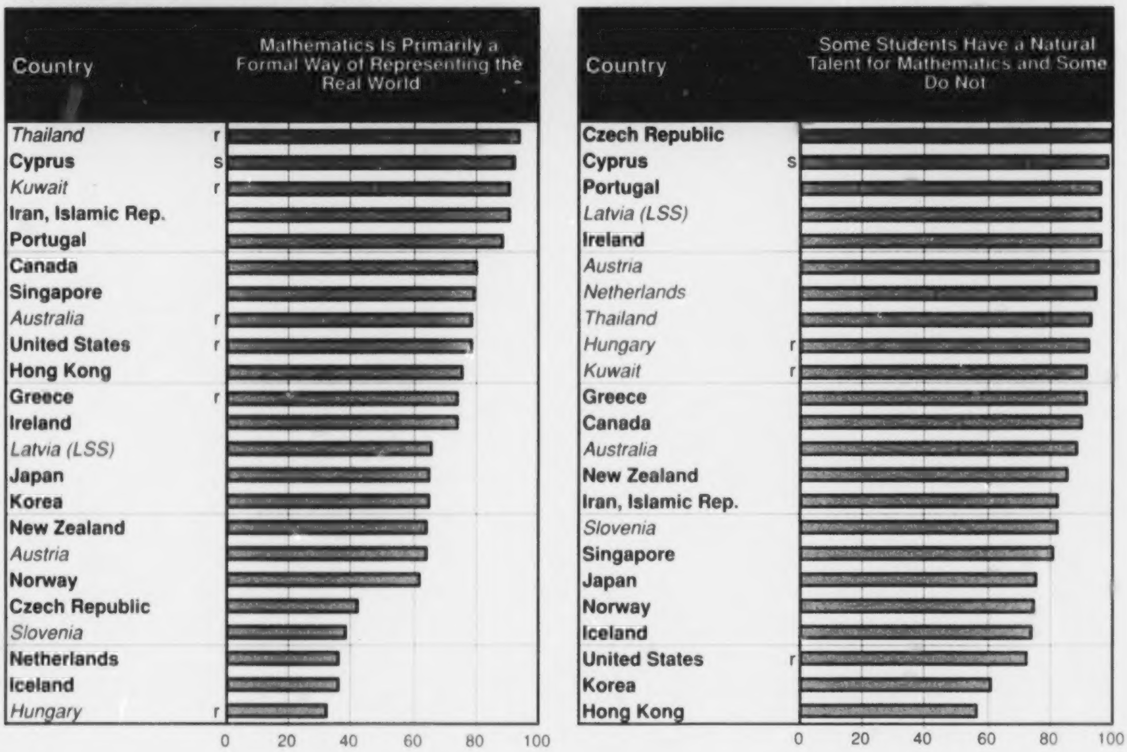
Regarding perceptions about how to teach mathematics, teachers' opinions varied across countries on whether more individual practice during class is an effective approach to help students having difficulty. At least 90% of the fourth-grade students in Cyprus, Greece, Iran, Portugal, the Czech Republic, and Latvia (LSS) had teachers who agreed or strongly agreed with this approach. Conversely, fewer than 20% of the students in the United States and Norway had teachers who agreed that having students practice on their own was an effective approach.

There was nearly complete agreement by teachers across countries that more than one representation should be used in teaching a mathematics topic. More than 90% of the fourth-grade students in every country had teachers who agreed with this approach. This instructional strategy is particularly useful in helping students with different learning styles understand key ideas. Also, using data in different formats reinforces the idea of mathematics as a network of interconnected concepts and procedures.

TIMSS also queried teachers about the cognitive demands of mathematics, asking them to rate the importance of various skills for success in the discipline. Figure 5.2 shows the percentages of students whose teachers rated each of four different skills as very important. Across the participating countries, the fewest students had teachers who believed that the ability to remember formulas and procedures was very important. There was a range, however, with teachers of approximately 80% of the fourth-grade students in Kuwait rating this ability as very important, compared with the teachers of 20% or fewer of the students in Portugal, Cyprus, Slovenia, and Austria.

Figure 5.1

Percent of Students Whose Mathematics Teachers Agree or Strongly Agree with Statements About the Nature of Mathematics and Mathematics Teaching Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

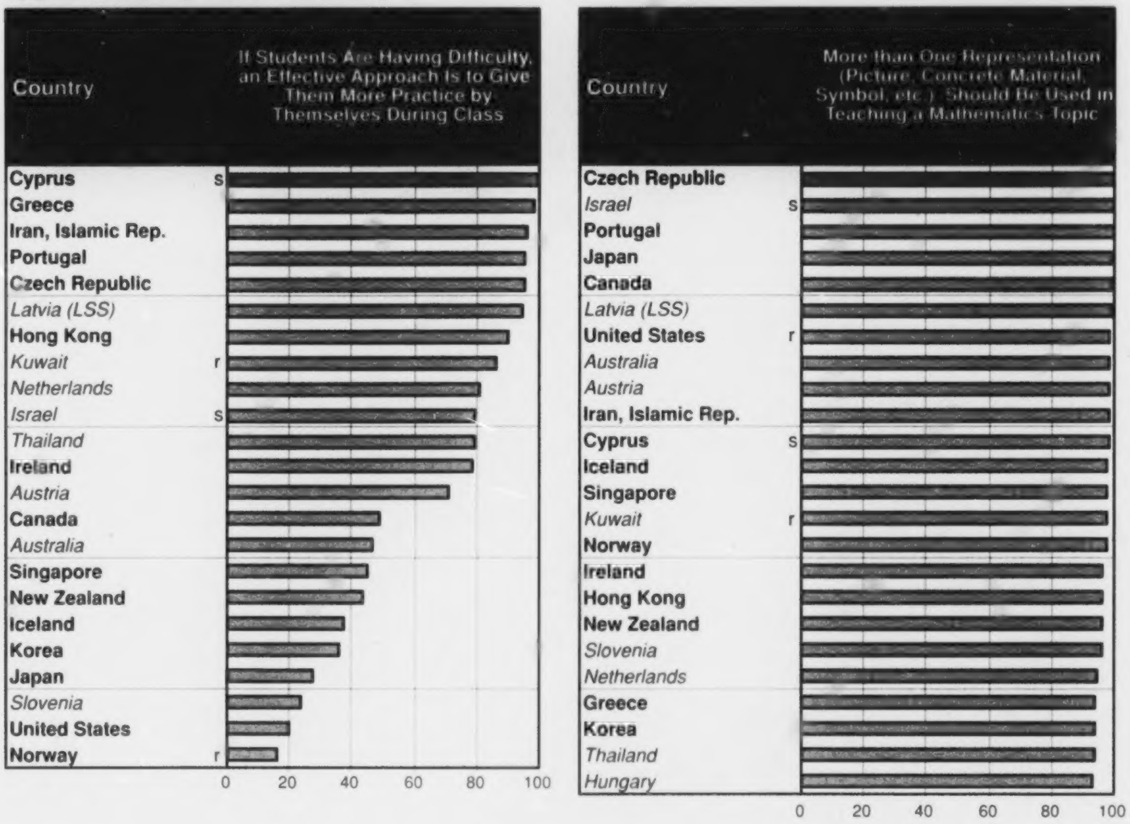
Israel omitted from the questions about mathematics being a formal way of representing the real world and students having a natural talent for mathematics; teacher response data available for <50% of students.

England and Scotland did not ask these questions. Hungary did not ask teachers their opinions about the effectiveness of more individual practice.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.1 (Continued)

Percent of Students Whose Mathematics Teachers Agree or Strongly Agree with Statements About the Nature of Mathematics and Mathematics Teaching Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

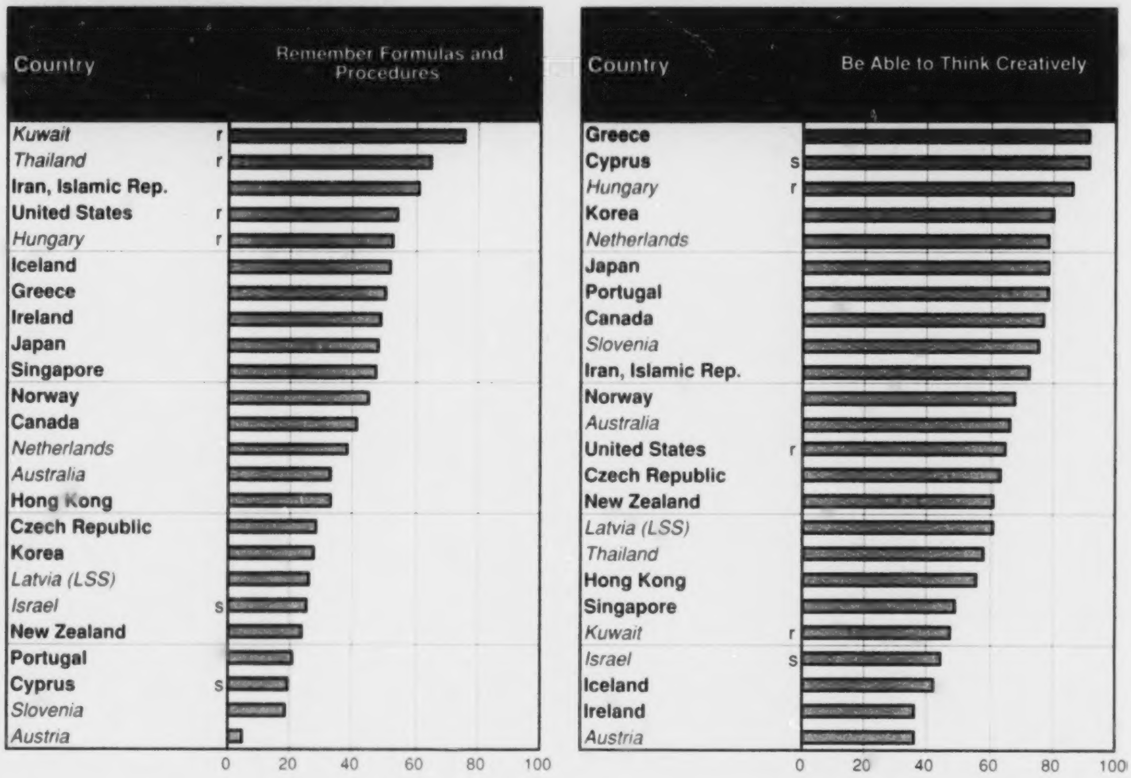
Israel omitted from the questions about mathematics being a formal way of representing the real world and students having a natural talent for mathematics; teacher response data available for <50% of students.

England and Scotland did not ask these questions. Hungary did not ask teachers their opinions about the effectiveness of more individual practice.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.2

Percent of Students Whose Mathematics Teachers Think Particular Abilities Are Very Important for Students' Success in Mathematics in School Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

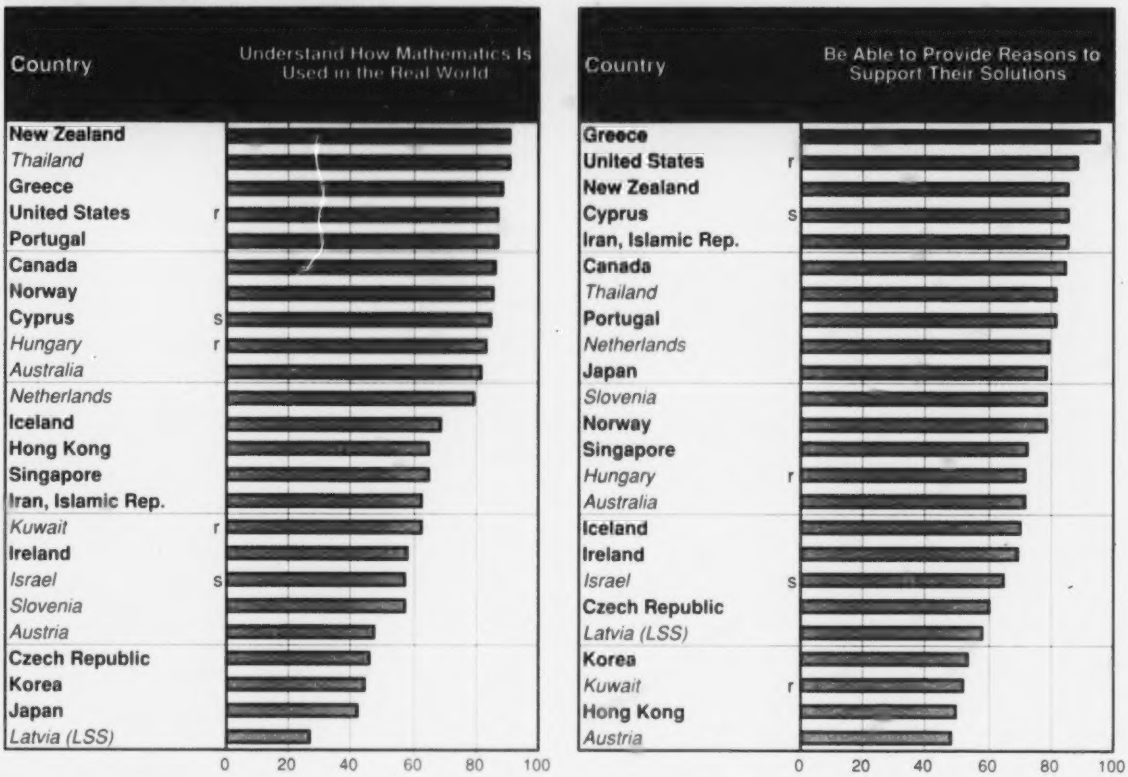
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

England and Scotland did not ask these questions.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.2 (Continued)

Percent of Students Whose Mathematics Teachers Think Particular Abilities Are Very Important for Students' Success in Mathematics in School Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.
England and Scotland did not ask these questions.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Internationally, most mathematics teachers indicated that it was very important for students to be able to think creatively, to understand how mathematics is used in the real world, and to be able to provide reasons to support their solutions. However, there was some variation across countries. Fewer than 40% of the fourth-grade students in Ireland and Austria had teachers who felt it was very important to think creatively, and fewer than 40% in Latvia (LSS) had teachers who felt it was very important to understand how mathematics is used in the real world. In all countries except Austria, the majority of students had teachers who felt it was very important to be able to provide reasons to support mathematical solutions. Still, with the current calls from business and industry for helping students improve their ability to apply mathematics and solve practical problems in job-related situations, it seems rather surprising that teachers do not place more importance on these three aspects of mathematics.

How Do Mathematics Teachers Spend Their School-Related Time?

As shown in Table 5.4, teachers in most countries reported that mathematics classes typically meet for three or four hours a week, on average. However, more than 5 hours of weekly class time was reported for 50% or more of the fourth-grade students in the Netherlands, Portugal, Singapore, and Thailand. The data reveal no clear pattern among the number of in-class instructional hours and mathematics achievement either across or between countries. Common sense and research both support the idea that increased time on task can yield commensurate increases in achievement, yet this time also can be spent outside of school on homework or in special tutoring. Further, the time in class may not be used effectively. The ability to use straightforward analyses such as these to disentangle complicated relationships also is made difficult by the practice of providing additional in-school instruction for lower-performing students.

In many countries around the world, primary school classes are taught by a single teacher who is responsible for teaching all subjects in the curriculum. As shown in Figure 5.3, most students also were taught science by the same teachers who taught them mathematics. However, this was not the case for all students in a number of countries. In Hong Kong, Israel, and Kuwait, all or nearly all of the students had different teachers for mathematics and science.

In addition to the time spent in class on mathematics instruction, teachers were asked about the number of hours per week spent on selected school-related activities outside the regular school day. Table 5.5 presents the results. For example, on average, fourth-grade students in Australia had mathematics teachers who spent 1.2 hours per week preparing or grading tests, and another 2.8 hours per week reading and grading papers. Their teachers spent 2.9 hours per week on lesson planning and 1.5 hours combined on meetings with students and parents. They spent 1.4 hours on professional reading and development and 4.3 hours on record-keeping and administrative tasks combined. Across countries, teachers reported that grading student work and lesson planning were the most time consuming activities, often averaging about five to six hours per week. In general, teachers also reported several hours per week spent on keeping students' records and other administrative tasks.

Table 5.4

Teachers' Reports on Average Number of Hours Mathematics Is Taught Weekly to Their Mathematics Classes - Upper Grade (Fourth Grade*)

Country	Less than 2 Hours		2 Hours to < 3.5		3.5 Hours to < 5		5 Hours or More		Average Hours
	Percent of Students	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	
Australia	r 0 (0.3)	~ ~	24 (2.7)	536 (7.0)	37 (3.7)	537 (5.5)	38 (3.4)	561 (5.8)	r 4.2 (0.06)
Austria	0 (0.0)	~ ~	92 (2.4)	562 (3.6)	8 (2.4)	532 (13.7)	0 (0.0)	~ ~	3.4 (0.02)
Canada	3 (1.2)	541 (28.9)	19 (2.2)	526 (5.1)	39 (3.6)	529 (6.0)	39 (3.6)	539 (6.0)	4.4 (0.09)
Cyprus	s 0 (0.0)	~ ~	4 (2.5)	497 (25.8)	88 (5.3)	507 (3.9)	9 (4.9)	503 (39.2)	s 4.1 (0.08)
Czech Republic	3 (1.4)	587 (11.3)	0 (0.3)	~ ~	94 (2.0)	566 (3.5)	3 (1.4)	565 (8.3)	3.7 (0.05)
England	0 (0.2)	~ ~	11 (2.8)	508 (10.9)	48 (4.8)	513 (5.9)	41 (5.0)	518 (6.0)	4.6 (0.10)
Greece	- -	- -	- -	- -	- -	- -	- -	- -	- -
Hong Kong	6 (2.0)	591 (13.4)	11 (2.9)	576 (16.8)	76 (4.2)	590 (5.3)	7 (2.3)	586 (12.6)	3.8 (0.10)
Hungary	0 (0.0)	~ ~	72 (4.4)	549 (4.1)	25 (4.2)	548 (9.1)	3 (1.5)	541 (28.2)	3.3 (0.06)
Iceland	0 (0.1)	~ ~	89 (3.4)	476 (3.1)	9 (3.2)	460 (4.9)	2 (1.2)	~ ~	3.2 (0.06)
Iran, Islamic Rep.	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ireland	6 (1.9)	538 (20.2)	19 (3.4)	544 (7.0)	34 (4.5)	549 (5.3)	41 (4.8)	557 (6.9)	4.2 (0.11)
Israel	x x	x x	x x	x x	x x	x x	x x	x x	x x
Japan	1 (0.5)	~ ~	6 (2.2)	595 (4.2)	92 (2.3)	597 (2.2)	2 (1.1)	~ ~	3.7 (0.03)
Korea	0 (0.0)	~ ~	93 (2.0)	612 (2.3)	6 (1.7)	586 (12.7)	2 (1.0)	~ ~	2.9 (0.04)
Kuwait	r 1 (1.0)	~ ~	99 (1.0)	401 (3.0)	0 (0.0)	~ ~	0 (0.0)	~ ~	r 2.9 (0.03)
Latvia (LSS)	0 (0.5)	~ ~	82 (3.6)	524 (5.3)	13 (3.4)	530 (17.9)	4 (1.3)	501 (24.6)	3.5 (0.05)
Netherlands	0 (0.0)	~ ~	5 (2.2)	564 (15.5)	39 (4.6)	578 (5.1)	56 (4.7)	578 (5.1)	4.7 (0.06)
New Zealand	7 (2.2)	502 (11.4)	34 (4.1)	496 (8.6)	45 (4.2)	505 (6.0)	14 (3.1)	503 (11.0)	3.6 (0.09)
Norway	6 (2.2)	510 (10.0)	77 (3.6)	501 (3.6)	16 (2.8)	501 (9.1)	1 (1.1)	~ ~	3.0 (0.07)
Portugal	0 (0.0)	~ ~	8 (2.4)	476 (8.7)	10 (2.7)	479 (9.8)	81 (3.4)	474 (4.2)	5.7 (0.15)
Scotland	r 2 (0.9)	~ ~	17 (3.3)	509 (8.5)	39 (4.7)	518 (7.3)	42 (4.9)	529 (8.4)	r 4.3 (0.10)
Singapore	0 (0.0)	~ ~	0 (0.0)	~ ~	2 (1.2)	~ ~	98 (1.2)	624 (5.3)	5.5 (0.01)
Slovenia	1 (0.8)	~ ~	2 (1.3)	~ ~	93 (2.6)	550 (3.6)	5 (2.2)	569 (13.2)	3.8 (0.05)
Thailand	r 2 (0.7)	~ ~	4 (1.5)	447 (18.2)	38 (5.2)	505 (8.6)	56 (5.7)	485 (8.3)	r 4.6 (0.09)
United States	r 12 (2.4)	539 (10.2)	9 (2.4)	554 (6.6)	33 (3.6)	557 (5.8)	46 (4.1)	542 (4.8)	r 4.2 (0.11)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.
An "x" indicates teacher response data available for <50% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.3

Percent of Students Who Are Taught Both Mathematics and Science by a Single Classroom Teacher[1] - Upper Grade (Fourth Grade*)

Austria
Greece
Iran, Islamic Rep.
Ireland
Japan
Korea
Netherlands
Portugal
Scotland
Slovenia

100%

Australia (97%)
Canada (88%)
Czech Republic (82%)
England (89%)
Iceland (89%)
New Zealand (91%)
Norway (77%)
United States (94%)

75-99%

Cyprus (59%)
Hong Kong (13%)
Hungry (47%)
Israel (24%)
Kuwait (0%)
Latvia (LSS) (69%)
Singapore (50%)
Thailand (67%)

<75%

---

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Based on information provided by schools. Teachers were classified as teaching: (1) mathematics, (2) science, or (3) both mathematics and science to the sampled classes. Percentages reflect those students taught by category (3) teachers.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.5

Average Number of Hours[1] Students' Teachers Spend on Various School-Related Activities Outside the Formal School Day During the School Week Mathematics - Upper Grade (Fourth Grade*)

Country	Preparing or Grading Tests	Reading and Grading Student Work	Planning Lessons by Self	Meeting with Students Outside Classroom Time	Meeting with Parents	Profess-ional Reading and Develop-ment	Keeping Students' Records	Adminis-trative Tasks
Australia	1.2 (0.1)	2.8 (0.1)	2.9 (0.1)	r 0.7 (0.1)	0.8 (0.1)	1.4 (0.1)	1.3 (0.1)	3.0 (0.1)
Austria	2.6 (0.2)	4.0 (0.1)	3.3 (0.1)	0.3 (0.0)	0.8 (0.1)	1.5 (0.1)	1.1 (0.1)	1.5 (0.1)
Canada	1.7 (0.1)	2.9 (0.1)	2.9 (0.1)	1.0 (0.1)	0.6 (0.0)	1.1 (0.1)	1.4 (0.1)	2.4 (0.1)
Cyprus	s 2.2 (0.1)	s 2.6 (0.1)	s 3.3 (0.2)	s 0.3 (0.2)	s 0.8 (0.2)	s 1.4 (0.2)	s 1.0 (0.1)	s 1.6 (0.2)
Czech Republic	2.7 (0.1)	3.0 (0.1)	3.4 (0.1)	1.2 (0.1)	0.5 (0.0)	1.8 (0.1)	1.1 (0.1)	1.0 (0.1)
England	r 1.0 (0.1)	4.0 (0.1)	3.4 (0.1)	1.0 (0.1)	0.8 (0.1)	1.2 (0.1)	1.5 (0.1)	3.2 (0.1)
Greece	2.5 (0.1)	2.1 (0.1)	r 1.9 (0.1)	r 0.3 (0.0)	0.9 (0.0)	1.9 (0.1)	r 0.5 (0.1)	r 1.1 (0.1)
Hong Kong	2.7 (0.2)	3.9 (0.2)	1.9 (0.1)	1.8 (0.2)	0.6 (0.1)	0.8 (0.1)	0.4 (0.0)	1.1 (0.1)
Hungary	2.5 (0.1)	2.6 (0.1)	3.5 (0.1)	1.7 (0.1)	0.8 (0.0)	1.9 (0.1)	0.8 (0.1)	2.3 (0.1)
Iceland	1.0 (0.1)	3.1 (0.2)	3.7 (0.1)	0.6 (0.1)	0.7 (0.1)	1.2 (0.1)	1.3 (0.1)	2.3 (0.2)
Iran, Islamic Rep.	2.2 (0.1)	2.2 (0.1)	2.0 (0.1)	1.2 (0.1)	1.3 (0.1)	1.0 (0.1)	1.7 (0.1)	1.1 (0.1)
Ireland	1.2 (0.1)	2.1 (0.2)	1.6 (0.1)	0.3 (0.0)	0.4 (0.0)	0.6 (0.1)	0.8 (0.1)	1.0 (0.1)
Israel	s 3.1 (0.3)	s 2.7 (0.2)	s 3.3 (0.2)	s 1.4 (0.2)	s 1.1 (0.1)	x x	x x	s 2.0 (0.2)
Japan	2.4 (0.1)	3.0 (0.1)	2.7 (0.1)	1.3 (0.1)	0.4 (0.0)	2.1 (0.1)	1.7 (0.1)	2.4 (0.1)
Korea	1.5 (0.1)	2.2 (0.1)	2.1 (0.1)	1.4 (0.1)	0.5 (0.0)	1.5 (0.1)	1.3 (0.1)	2.0 (0.1)
Kuwait	r 2.1 (0.1)	r 1.6 (0.1)	r 1.9 (0.1)	s 0.3 (0.1)	r 0.7 (0.1)	r 0.9 (0.1)	r 1.2 (0.1)	r 1.3 (0.1)
Latvia (LSS)	2.0 (0.1)	2.8 (0.2)	2.8 (0.2)	2.1 (0.2)	1.0 (0.1)	1.5 (0.2)	1.0 (0.1)	1.2 (0.1)
Netherlands	1.5 (0.1)	3.8 (0.1)	2.6 (0.1)	0.9 (0.1)	0.8 (0.0)	1.1 (0.1)	0.9 (0.1)	2.8 (0.1)
New Zealand	1.3 (0.1)	2.7 (0.1)	3.1 (0.1)	0.7 (0.1)	0.7 (0.0)	1.5 (0.1)	1.7 (0.1)	3.3 (0.1)
Norway	1.3 (0.1)	2.3 (0.1)	3.8 (0.2)	0.6 (0.0)	0.8 (0.1)	0.7 (0.1)	0.8 (0.1)	1.8 (0.1)
Portugal	2.4 (0.1)	2.7 (0.1)	2.4 (0.1)	0.6 (0.1)	0.7 (0.0)	1.4 (0.1)	0.9 (0.1)	1.5 (0.1)
Scotland	r 0.8 (0.1)	r 3.2 (0.1)	3.3 (0.1)	0.2 (0.0)	r 0.4 (0.0)	1.1 (0.1)	1.1 (0.1)	2.5 (0.1)
Singapore	3.2 (0.1)	4.2 (0.1)	2.4 (0.1)	2.3 (0.1)	0.6 (0.0)	1.5 (0.1)	1.2 (0.1)	2.3 (0.1)
Slovenia	2.3 (0.1)	2.1 (0.1)	3.7 (0.2)	1.1 (0.1)	1.3 (0.1)	2.2 (0.2)	0.8 (0.1)	1.9 (0.1)
Thailand	r 2.5 (0.2)	r 2.4 (0.2)	r 2.8 (0.2)	r 1.9 (0.2)	1.7 (0.2)	r 2.2 (0.2)	r 1.7 (0.2)	2.0 (0.2)
United States	2.2 (0.1)	3.1 (0.1)	2.5 (0.1)	0.9 (0.1)	0.7 (0.0)	1.3 (0.1)	1.4 (0.1)	2.2 (0.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours = 1.5; 3-4 hours = 3.5; More than 4 hours = 5.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.6

Teachers' Reports on How Often They Meet with Other Teachers in Their Subject Area to Discuss and Plan Curriculum or Teaching Approaches Mathematics - Upper Grade (Fourth Grade*)

Country		Percent of Students Taught by Teachers			
		Meeting Never or Once/Twice a Year	Meeting Monthly or Every Other Month	Meeting Once, Twice, or Three Times a Week	Meeting Almost Every Day
Australia		7 (1.8)	33 (3.5)	50 (3.8)	10 (2.7)
Austria		19 (4.4)	23 (4.6)	36 (4.6)	22 (4.1)
Canada		32 (3.6)	33 (3.4)	29 (2.9)	7 (1.8)
Cyprus	s	9 (2.7)	13 (4.3)	65 (5.4)	13 (4.2)
Czech Republic		5 (1.7)	13 (2.5)	33 (4.0)	49 (4.5)
England		4 (1.6)	11 (3.1)	72 (4.4)	13 (3.1)
Greece		32 (3.9)	26 (3.3)	26 (3.7)	16 (3.3)
Hong Kong		66 (5.2)	23 (4.1)	9 (3.8)	1 (1.0)
Hungary		3 (2.0)	13 (3.0)	42 (4.9)	42 (4.6)
Iceland		16 (1.6)	15 (4.3)	67 (4.1)	2 (1.2)
Iran, Islamic Rep.		4 (1.5)	26 (4.3)	54 (4.9)	16 (3.2)
Ireland		46 (5.0)	42 (4.7)	7 (2.0)	5 (1.5)
Israel	s	8 (4.2)	36 (7.7)	47 (8.6)	9 (4.3)
Japan		5 (1.7)	14 (3.0)	61 (4.2)	20 (3.9)
Korea		17 (3.0)	24 (3.5)	41 (4.2)	18 (3.2)
Kuwait	r	4 (2.0)	2 (1.1)	76 (4.4)	19 (4.3)
Latvia (LSS)		9 (2.8)	25 (3.9)	36 (4.9)	29 (4.3)
Netherlands		36 (4.4)	33 (4.4)	29 (3.8)	2 (1.5)
New Zealand		11 (2.7)	17 (3.2)	60 (4.3)	12 (2.6)
Norway		5 (1.7)	7 (2.4)	80 (3.6)	8 (2.8)
Portugal		10 (2.6)	62 (4.4)	17 (3.4)	11 (2.8)
Scotland		9 (2.3)	37 (4.3)	40 (4.0)	14 (2.9)
Singapore		9 (2.1)	68 (4.2)	21 (3.4)	3 (1.5)
Slovenia		4 (2.3)	33 (4.9)	31 (4.4)	32 (4.7)
Thailand	r	54 (5.8)	29 (5.6)	16 (4.7)	1 (0.5)
United States		19 (3.4)	20 (3.3)	50 (3.7)	11 (2.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Opportunities to meet with colleagues to plan curriculum or teaching approaches enable teachers to expand their views of mathematics, their resources for teaching, and their repertoire of teaching and learning skills. Table 5.6 contains teachers' reports on how often they meet with other teachers in their subject area to discuss and plan curriculum or teaching approaches. Teachers of the majority of the students reported weekly or daily planning meetings in Australia, Austria, Cyprus, the Czech Republic, England, Hungary, Iceland, Iran, Israel, Japan, Korea, Kuwait, Latvia (LSS), New Zealand, Norway, Scotland, Slovenia, and the United States. In the remaining countries, however, most students had mathematics teachers who reported only limited opportunities to plan curriculum or teaching approaches with other teachers (monthly or even yearly meetings).

HOW ARE MATHEMATICS CLASSES ORGANIZED?

Instructional organization can subsume many factors, including the diversity of the students placed into classrooms, the availability of instructional resources, the typical size of classes, and practices regarding in-class grouping. Often, how instruction is organized can influence the implemented curriculum and the opportunities of students.

Figure 5.4 presents teachers' reports about several factors that might limit how they teach their mathematics classes. The results are presented visually via pie graphs. The percentage of students whose teachers reported that a particular factor limited how they teach mathematics either "quite a lot" or "a great deal" also is shown next to each graph. Since tracking or streaming is relatively rare in the primary grades, it is perhaps not surprising that many teachers reported that the differing academic abilities of their students limited how they teach mathematics. Eighty percent or more of the students in Greece, Hungary, Iceland, and Iran had mathematics teachers who so reported. In general, fewer teachers reported that students with special needs or disruptive students limited their mathematics instruction. However, 60% or more of the students in Greece, Iran, and Portugal were in mathematics classes where instruction was reportedly limited by students with special needs, and similar percentages of students in Korea and Portugal were in classes where disruptive students limited instruction.

The availability of instructional resources also can affect the organization of instruction. Except in Austria, the Netherlands, and Scotland, one-fourth or more of the students had teachers who reported shortages of equipment for use in demonstrations and other exercises. The majority of the students were in such classrooms in Cyprus, Greece, Iran, Korea, Kuwait, Latvia (LSS), Portugal, Slovenia, and Thailand. In Greece, Iran, Latvia (LSS), and Thailand, teachers also reported that the majority of students were in situations where inadequate physical facilities limited their mathematics teaching.

Teachers reported that high student/teacher ratios were a limiting instructional factor for the majority of students in more than half of the countries. The exceptions were Austria, Canada, the Czech Republic, Hungary, Japan, Latvia (LSS), the Netherlands, Norway, Scotland, Thailand, and the United States. Even for these countries, however, only the teachers in Austria and Latvia (LSS) reported that student/teachers ratios affected instruction for fewer than 20% of the students.

Figure 5.4

Teachers' Reports on What Factors Limit How They Teach Class Mathematics - Upper Grade (Fourth Grade*)

Country	Percent of Students Whose Teachers Report Each Factor Limiting How They Teach Class "Quite A Lot" or "A Great Deal"					
	Students with Different Academic Abilities	Students with Special Needs	Disruptive Students	Shortage of Equipment for Use in Demonstrations and Other Exercises	Inadequate Physical Facilities	High Student/Teacher Ratio
Australia	r 45	r 27	r 38	r 31	r 24	r 51
Austria	47	1	10	7	7	15
Canada	47	28	46	31	26	46
Cyprus	s 77	s 56	s 53	s 55	s 35	s 82
Czech Republic	64	22	39	48	28	38
Greece	81	r 60	44	r 65	50	64
Hong Kong	53	16	22	26	25	57
Hungary	92	55	44	42	32	37
Iceland	87	r 51	53	49	r 44	67
Iran, Islamic Rep.	81	75	45	79	55	58
Ireland	69	28	37	28	20	54
Japan	60	-	-	28	-	41

Percent for "Quite a Lot" or "A Great Deal" → ◑

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
Countries where data were not available or where teacher response data were available for <50% of students are omitted from the figure (England and Israel).
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.4 (Continued)

Teachers' Reports on What Factors Limit How They Teach Class Mathematics - Upper Grade (Fourth Grade*)

Country	Students with Different Academic Abilities	Students with Special Needs	Disruptive Students	Shortage of Equipment for Use in Demonstrations and Other Exercises	Inadequate Physical Facilities	High Student/Teacher Ratio
	Percent of Students Whose Teachers Report Each Factor Limiting How They Teach Class "Quite A Lot" or "A Great Deal"					
Korea	69	41	64	54	27	62
Kuwait	r 57	r 56	r 40	r 62	r 39	r 78
Latvia (LSS)	r 25	r 16	r 22	r 77	r 60	r 14
Netherlands	63	21	31	18	19	r 35
New Zealand	45	26	27	31	25	59
Norway	58	35	26	41	14	48
Portugal	74	66	74	59	23	r 53
Scotland	63	32	31	11	21	39
Singapore	66	22	42	25	17	60
Slovenia	24	16	50	61	46	52
Thailand	68	36	21	67	r 65	48
United States	r 41	r 19	r 31	r 25	r 15	r 38

Percent for "Quite a Lot" or "A Great Deal" → ◔

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
Countries where data were not available or where teacher response data were available for <50% of students are omitted from the figure (England and Israel).
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.7 presents teachers' reports about the size of fourth-grade mathematics classes for the TIMSS countries. The data reveal rather large variations from country to country, with the average class size ranging from 19 in Norway to 43 in Korea. According to teachers, mathematics classes were relatively small in a number of countries. For example, 90% or more of the students were in mathematics classes of 30 or fewer students in Austria, Canada, the Czech Republic, Greece, Hungary, Iceland, Latvia (LSS), Norway, Portugal, Slovenia, and the United States. At the other end of the spectrum, 69% of the students in Korea were in mathematics classes with more than 40 students and 93% were in classes with more than 30 students. Similarly, 98% of the students in Singapore, 87% in Hong Kong, and 68% in Japan were in classes with more than 30 students.

Extensive research about class size in relation to achievement indicates that the existence of such a relationship is dependent on the situation. Dramatic reductions in class size can be related to gains in achievement, but the chief effects of smaller classes often are in relation to teacher attitudes and instructional strategies. The TIMSS data support the complexity of this issue. Across countries, the four highest-performing countries at the fourth grade – Singapore, Korea, Japan, and Hong Kong – are among those with the largest mathematics classes. Within countries, several show little or no relationship between achievement and class size, often because students are almost all in classes of similar size. Within other countries, there appears to be a curvilinear relationship, or the students with higher achievement appear to be in larger classes. In some countries, larger classes may represent the more usual situation for mathematics teaching, with smaller classes used primarily for students needing remediation.

Teachers can adopt a variety of organizational and interactive approaches in mathematics class. Whole-class instruction can be very efficient because it requires less time on management functions and provides more time for developing mathematics concepts. Teachers can make presentations, conduct discussions, or demonstrate procedures and applications to all students simultaneously. Both whole-class and independent work have been standard features of mathematics classrooms. Students also can benefit from the type of cooperative learning that occurs with effective use of small-group work. Because they can help each other, students in groups can often handle challenging situations beyond their individual capabilities. Further, the positive affective impact of working together mirrors the use of mathematics in the workplace.

Figure 5.5 provides a pictorial view of the emphasis on individual, small-group, and whole-class work as reported by the mathematics teachers in the TIMSS countries. Because learning may be enhanced with teacher guidance and monitoring of individual and small-group activities, the frequency of lessons using each of these organizational approaches is shown both with and without assistance of the teacher. Internationally, teachers reported that students working together as a class with the teacher teaching the whole class is a frequently used instructional approach. In many countries, approximately 50% or even more of the fourth-grade students were taught this way during most or all lessons. In contrast, students working together as a class and responding to each other appeared to be a much less common approach, used for about one-third or fewer of the students on a frequent basis, except in Japan and Korea.

Table 5.7

Teachers' Reports on Average Size of Mathematics Class Upper Grade (Fourth Grade*)

Country	1 - 20 Students		21 - 30 Students		31 - 40 Students		41 or More Students		Average Number of Students
	Percent of Students	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	
Australia	r 17 (3.1)	551 (5.6)	64 (4.8)	546 (5.4)	19 (4.7)	543 (10.0)	0 (0.0)	~ ~	r 25 (0.6)
Austria	50 (5.0)	567 (5.5)	50 (5.0)	553 (4.0)	0 (0.0)	~ ~	0 (0.0)	~ ~	20 (0.5)
Canada	18 (2.4)	552 (9.3)	75 (2.7)	529 (3.7)	6 (1.3)	525 (7.8)	0 (0.2)	~ ~	24 (0.3)
Cyprus	s 6 (1.7)	514 (8.5)	66 (5.2)	505 (4.2)	28 (5.4)	510 (12.4)	0 (0.0)	~ ~	s 28 (0.5)
Czech Republic	32 (3.6)	552 (4.8)	65 (3.7)	572 (3.6)	3 (1.4)	641 (42.8)	0 (0.0)	~ ~	22 (0.4)
England	9 (2.7)	534 (21.7)	56 (4.8)	512 (4.4)	35 (4.8)	515 (7.0)	0 (0.0)	~ ~	28 (0.5)
Greece	45 (3.9)	490 (7.1)	53 (4.0)	497 (5.1)	2 (1.1)	~ ~	0 (0.0)	~ ~	21 (0.4)
Hong Kong	0 (0.4)	~ ~	13 (4.1)	573 (22.5)	74 (4.8)	590 (5.1)	13 (3.2)	608 (8.7)	36 (0.5)
Hungary	38 (3.4)	539 (5.2)	58 (3.5)	554 (5.0)	4 (1.7)	565 (24.6)	0 (0.0)	~ ~	22 (0.4)
Iceland	46 (5.0)	475 (4.9)	54 (5.0)	476 (3.4)	0 (0.0)	~ ~	0 (0.0)	~ ~	20 (0.4)
Iran, Islamic Rep.	17 (3.7)	396 (7.0)	24 (3.9)	424 (8.0)	38 (4.2)	447 (7.4)	21 (3.7)	434 (6.5)	32 (0.9)
Ireland	27 (2.8)	555 (5.5)	33 (4.3)	541 (7.3)	41 (4.7)	557 (5.2)	0 (0.0)	~ ~	26 (0.6)
Israel	x x	x x	x x	x x	x x	x x	x x	x x	x x
Japan	3 (0.8)	593 (5.3)	29 (3.5)	595 (3.3)	67 (3.6)	598 (2.7)	1 (1.1)	~ ~	32 (0.4)
Korea	2 (1.0)	~ ~	6 (1.6)	583 (9.7)	24 (3.6)	602 (5.1)	69 (3.5)	617 (2.8)	43 (0.6)
Kuwait	r 0 (0.0)	~ ~	36 (4.5)	408 (5.5)	63 (4.7)	397 (3.7)	1 (1.3)	~ ~	r 32 (0.3)
Latvia (LSS)	53 (3.8)	518 (7.1)	44 (3.5)	535 (6.5)	3 (1.6)	532 (18.4)	0 (0.0)	~ ~	20 (0.4)
Netherlands	29 (4.0)	576 (7.5)	52 (5.5)	573 (4.8)	19 (4.4)	588 (4.6)	0 (0.0)	~ ~	24 (0.7)
New Zealand	13 (2.6)	500 (11.5)	37 (4.3)	490 (8.6)	50 (4.5)	507 (5.9)	0 (0.0)	~ ~	29 (0.5)
Norway	59 (4.4)	504 (4.2)	41 (4.4)	496 (4.6)	0 (0.0)	~ ~	0 (0.0)	~ ~	19 (0.4)
Portugal	39 (3.8)	468 (6.3)	60 (3.7)	479 (4.8)	1 (0.6)	~ ~	0 (0.0)	~ ~	21 (0.4)
Scotland	15 (2.3)	545 (6.3)	70 (3.5)	515 (5.2)	14 (3.3)	521 (8.6)	1 (1.0)	~ ~	26 (0.5)
Singapore	0 (0.0)	~ ~	2 (0.8)	~ ~	68 (3.3)	620 (5.8)	30 (3.2)	646 (11.0)	39 (0.2)
Slovenia	32 (4.5)	540 (7.7)	68 (4.5)	556 (4.1)	0 (0.0)	~ ~	0 (0.0)	~ ~	23 (0.4)
Thailand	28 (4.1)	490 (5.4)	29 (4.9)	493 (10.9)	36 (5.7)	495 (11.4)	7 (5.2)	445 (1.7)	27 (2.0)
United States	r 23 (3.6)	544 (5.7)	67 (3.8)	555 (4.3)	9 (1.7)	517 (7.8)	1 (0.5)	~ ~	r 24 (0.5)

*Fourth grade in most countries: see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

An "x" indicates teacher response data available for <50% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.5

Teachers' Reports About Classroom Organization During Mathematics Lessons Upper Grade (Fourth Grade*)

Country	Percent of Students Whose Teachers Report Using Each Organizational Approach "Most or Every Lesson"					
	Work Together as a Class with Students Responding to One Another	Work Together as a Class with Teacher Teaching the Whole Class	Work Individually with Assistance from Teacher	Work Individually without Assistance from Teacher	Work in Pairs or Small Groups with Assistance from Teacher	Work in Pairs or Small Groups without Assistance from Teacher
Australia	r 17	r 31	r 47	r 24	r 20	r 10
Austria	8	38	60	39	21	21
Canada	18	37	49	23	24	10
Cyprus	s 10	s 41	s 29	s 28	s 31	s 24
Czech Republic	12	49	52	71	8	6
England	10	11	55	12	21	7
Greece	r 9	r 61	54	r 21	17	5
Hong Kong	5	39	49	1	3	1
Hungary	10	53	78	40	16	6
Iceland	0	32	66	35	9	5
Iran, Islamic Rep.	31	72	57	7	32	10
Ireland	16	61	55	46	9	4
Japan	50	78	34	25	7	2

Percent for "Most or Every Lesson"→ ◐

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Israel omitted from the figure; teacher response data available for <50% of students.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.5 (Continued)

Teachers' Reports About Classroom Organization During Mathematics Lessons Upper Grade (Fourth Grade*)

Country	Percent of Students Whose Teachers Report Using Each Organizational Approach "Most or Every Lesson"					
	Work Together as a Class with Students Responding to One Another	Work Together as a Class with Teacher Teaching the Whole Class	Work Individually with Assistance from Teacher	Work Individually without Assistance from Teacher	Work in Pairs or Small Groups with Assistance from Teacher	Work in Pairs or Small Groups without Assistance from Teacher
Korea	50	77	57	37	30	20
Kuwait	s 3	s 47	r 55	r 26	r 10	r 3
Latvia (LSS)	34	89	77	78	21	13
Netherlands	34	60	56	44	5	5
New Zealand	20	16	47	25	47	24
Norway	18	64	77	7	16	5
Portugal	14	68	69	25	32	5
Scotland	2	3	44	17	25	6
Singapore	23	68	37	41	25	10
Slovenia	17	47	79	53	45	27
Thailand	10	52	r 57	18	40	7
United States	r 32	r 54	r 55	r 15	r 20	r 11

Percent for "Most or Every Lesson" → ◐

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Israel omitted from the figure; teacher response data available for <50% of students.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Perhaps even more popular than having students working together as a class with the teacher teaching the whole class was having students work individually with assistance from the teacher. Group work was reported to be the least frequent approach, but when such an approach was indicated, it was more often with than without the assistance of the teacher. Group work both with and without teacher assistance was reported most often for students in Cyprus, Iran, Korea, New Zealand, and Slovenia. In general, however, having students work without the assistance of the teacher, either individually or in groups, was not common in most countries, except the Czech Republic and Latvia (LSS).

WHAT ACTIVITIES DO STUDENTS DO IN THEIR MATHEMATICS LESSONS?

Most educational systems provide curriculum guides on either a national or a regional basis to ensure that teachers, parents, and other interested parties have a clear understanding of what is intended to be taught in each subject. Teachers' implementation of the intended curriculum, as represented by these national or regional educational policies and instructional objectives, can be determined by their knowledge of the relevant documents. The degree of teachers' familiarity with these documents can influence planning as well as the content delivered and the instructional methods used. Table 5.8 presents teachers' reports about their relative familiarity with the official national and/or regional curriculum guides in mathematics. Most commonly, teachers for the majority of the students reported being "fairly" familiar with these curriculum guides. In Austria, Hungary, Kuwait, and Slovenia, 80% or more of the fourth graders were taught mathematics by teachers who reported being "very" familiar with these documents.

As shown in Table 5.9, mathematics teachers in the participating countries generally reported heavier reliance on curriculum guides than textbooks or examination specifications in deciding which topics to teach. The exceptions were Greece, Iran, Ireland, Japan, Korea, the Netherlands, Norway, and Thailand, where teachers reported using textbooks more for this purpose than other sources of information. Often in countries with a national curriculum, the textbooks are prepared in close accordance with the curriculum guidelines. In almost all countries, the textbook was the major written source mathematics teachers used in deciding how to present a topic to their classes. Internationally, the textbook appears to play a role in mathematics classrooms in many countries. For nearly all students in all countries, teachers reported using a textbook in their mathematics classes (see Figure 5.6).

Table 5.8

Teachers' Reports on Their Familiarity With National and Regional Mathematics Curriculum Guides
Mathematics - Upper Grade (Fourth Grade*)

Country	Percent of Students by Teachers' Familiarity With					
	National Curriculum Guide			Regional Curriculum Guide		
	Not Familiar	Fairly Familiar	Very Familiar	Not Familiar	Fairly Familiar	Very Familiar
Australia	27 (3.9)	53 (4.6)	20 (3.1)	r 16 (3.3)	53 (4.6)	31 (4.2)
Austria	0 (0.0)	11 (2.9)	89 (2.9)	40 (4.9)	28 (4.3)	32 (4.9)
Canada	- -	- -	- -	10 (2.4)	38 (3.9)	52 (3.6)
Cyprus	s 1 (1.0)	33 (5.9)	66 (5.7)	- -	- -	- -
Czech Republic	42 (4.5)	42 (4.0)	16 (3.1)	91 (2.8)	8 (2.6)	1 (0.8)
England	- -	- -	- -	- -	- -	- -
Greece	r 22 (3.2)	52 (4.0)	26 (3.6)	- -	- -	- -
Hong Kong	21 (4.1)	66 (5.4)	14 (4.4)	- -	- -	- -
Hungary	0 (0.0)	12 (3.2)	88 (3.2)	- -	- -	- -
Iceland	9 (3.9)	69 (5.6)	22 (4.3)	- -	- -	- -
Iran, Islamic Rep.	32 (4.5)	51 (5.0)	17 (3.6)	- -	- -	- -
Ireland	4 (2.0)	58 (4.7)	38 (4.5)	- -	- -	- -
Israel	s 11 (4.6)	41 (7.7)	48 (8.3)	x x	x x	x x
Japan	35 (3.8)	64 (3.9)	1 (0.8)	58 (4.1)	41 (4.2)	1 (1.0)
Korea	19 (3.2)	63 (3.7)	19 (3.3)	56 (3.8)	37 (3.9)	7 (2.2)
Kuwait	r 6 (2.2)	15 (3.8)	80 (4.1)	- -	- -	- -
Latvia (LSS)	1 (0.8)	22 (3.6)	77 (3.7)	r 51 (5.2)	18 (3.7)	31 (4.8)
Netherlands	11 (3.0)	61 (4.7)	27 (4.4)	- -	- -	- -
New Zealand	3 (1.3)	55 (3.8)	42 (3.5)	76 (3.6)	19 (3.3)	5 (1.6)
Norway	6 (2.5)	66 (4.2)	27 (4.0)	58 (4.0)	30 (4.3)	12 (2.8)
Portugal	31 (4.5)	18 (3.4)	51 (4.4)	- -	- -	- -
Scotland	- -	- -	- -	- -	- -	- -
Singapore	1 (0.8)	40 (3.9)	60 (3.9)	- -	- -	- -
Slovenia	47 (4.8)	35 (5.0)	18 (3.6)	3 (2.1)	11 (3.7)	86 (4.2)
Thailand	4 (2.2)	21 (4.7)	76 (5.3)	r 56 (7.2)	33 (7.1)	11 (3.5)
United States	- -	- -	- -	r 36 (2.9)	38 (2.7)	26 (3.2)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

An "x" indicates teacher response data available for <50% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.9

Teachers' Reports on Their Main Sources of Written Information When Deciding Which Topics to Teach and How to Present a Topic[1] Mathematics - Upper Grade (Fourth Grade*)

Country	Percent of Students Taught by Teachers					
	Deciding Which Topics to Teach			Deciding How to Present a Topic		
	Curriculum Guide	Textbook	Examination Specifications	Curriculum Guide	Textbook	Examination Specifications
Australia	r 81 (4.1)	19 (4.1)	- -	r 35 (4.3)	65 (4.3)	- -
Austria	r 61 (5.0)	39 (5.0)	0 (0.0)	26 (4.3)	74 (4.3)	0 (0.0)
Canada	- -	- -	- -	- -	- -	- -
Cyprus	s 91 (2.5)	9 (2.5)	0 (0.0)	s 25 (3.8)	75 (3.8)	0 (0.0)
Czech Republic	79 (3.3)	21 (3.3)	- -	7 (2.2)	93 (2.2)	- -
England	77 (4.5)	23 (4.5)	- -	24 (4.8)	76 (4.8)	- -
Greece	r 42 (4.3)	58 (4.3)	- -	r 2 (1.2)	98 (1.2)	- -
Hong Kong	63 (5.6)	35 (5.5)	2 (1.1)	27 (5.3)	73 (5.3)	0 (0.0)
Hungary	86 (2.9)	10 (2.8)	4 (1.7)	22 (4.1)	78 (4.0)	1 (0.7)
Iceland	53 (4.5)	44 (4.6)	3 (2.0)	9 (3.0)	91 (3.0)	0 (0.0)
Iran, Islamic Rep.	41 (4.4)	54 (4.4)	5 (1.9)	34 (5.1)	62 (5.1)	4 (1.5)
Ireland	36 (5.0)	64 (5.0)	- -	13 (3.2)	87 (3.2)	- -
Israel	x x	x x	x x	x x	x x	x x
Japan	33 (4.1)	67 (4.1)	0 (0.0)	16 (3.2)	84 (3.2)	0 (0.0)
Korea	37 (3.9)	58 (3.9)	5 (1.8)	32 (3.8)	67 (3.9)	1 (0.6)
Kuwait	s - -	- -	- -	s - -	- -	- -
Latvia (LSS)	56 (4.9)	43 (4.9)	1 (0.9)	11 (3.0)	89 (3.0)	0 (0.0)
Netherlands	12 (3.0)	88 (3.0)	- -	6 (2.2)	94 (2.2)	- -
New Zealand	89 (3.0)	11 (3.0)	- -	31 (4.0)	69 (4.0)	- -
Norway	r 29 (4.9)	71 (4.9)	- -	3 (1.7)	97 (1.7)	- -
Portugal	95 (1.8)	5 (1.8)	- -	73 (4.0)	27 (4.0)	- -
Scotland	r 88 (3.1)	12 (3.1)	- -	r 22 (3.3)	78 (3.3)	- -
Singapore	77 (3.4)	22 (3.3)	2 (1.1)	2 (1.1)	98 (1.1)	0 (0.0)
Slovenia	89 (3.0)	10 (2.9)	1 (1.0)	14 (3.9)	83 (4.0)	2 (1.7)
Thailand	s 42 (7.8)	57 (7.7)	2 (1.0)	r 35 (6.9)	64 (6.9)	1 (0.8)
United States	r 67 (4.1)	27 (4.2)	6 (1.4)	r 14 (3.1)	84 (3.1)	1 (0.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Curriculum Guides include national, regional, and school curriculum guides; Textbooks include teacher and student editions, as well as other resource books; and Examination Specifications include national and regional levels.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

An "x" indicates teacher response data available for <50% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.6

Teachers' Reports About Using a Textbook in Teaching Mathematics Upper Grade (Fourth Grade*)

Countries are classified by percentage of students whose teachers reported that they use a textbook in teaching their mathematics class.

Cyprus[s]
Czech Republic
England
Hong Kong
Iceland[r]
Japan
Kuwait[s]
Latvia (LSS)[r]
Netherlands
Scotland
Singapore
Slovenia
Thailand

100%

Norway[r]
Austria
Greece
Ireland
Korea
Portugal
Canada
Iran, Islamic Rep.
United States[r]

95-99%

Hungary (94%)
New Zealand (75%)
Australia[r] (65%)

Other

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.
Israel omitted from the figure; teacher response data available for <50% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.10

Teachers' Reports on How Often They Ask Students to Practice Computational Skills - Mathematics - Upper Grade (Fourth Grade*)

Country	Never or Almost Never		Some Lessons		Most Lessons		Every Lesson	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	r 5 (2.2)	548 (24.0)	41 (4.2)	550 (6.1)	46 (4.15)	545.6 (5.3)	8 (2.1)	523.8 (10.0)
Austria	0 (0.0)	~ ~	9 (2.8)	581 (6.2)	51 (5.0)	564 (6.2)	39 (5.1)	551 (4.3)
Canada	1 (1.0)	~ ~	27 (3.2)	525 (8.5)	55 (3.3)	535 (4.7)	17 (3.1)	539 (6.7)
Cyprus	s 3 (1.7)	496 (10.6)	30 (5.0)	499 (6.2)	51 (6.7)	510 (5.8)	16 (4.9)	509 (20.6)
Czech Republic	0 (0.0)	~ ~	2 (1.0)	~ ~	20 (3.4)	563 (7.8)	78 (3.5)	569 (3.8)
England	- -	- -	- -	- -	- -	- -	- -	- -
Greece	- -	- -	- -	- -	- -	- -	- -	- -
Hong Kong	2 (1.3)	~ ~	37 (5.0)	597 (7.6)	36 (4.4)	586 (8.6)	25 (4.4)	575 (5.0)
Hungary	1 (0.7)	~ ~	1 (0.7)	~ ~	21 (3.8)	553 (7.0)	78 (3.7)	549 (4.6)
Iceland	0 (0.0)	~ ~	8 (3.0)	484 (7.7)	59 (5.7)	475 (4.3)	33 (5.0)	473 (4.2)
Iran, Islamic Rep.	15 (3.8)	433 (12.5)	59 (4.2)	426 (4.7)	21 (3.7)	435 (11.9)	5 (1.7)	419 (11.9)
Ireland	2 (0.9)	~ ~	15 (3.2)	552 (8.5)	52 (4.2)	549 (5.3)	32 (4.5)	554 (6.9)
Israel	x x	x x	x x	x x	x x	x x	x x	x x
Japan	- -	- -	- -	- -	- -	- -	- -	- -
Korea	8 (2.4)	601 (12.0)	45 (4.5)	611 (3.5)	39 (4.2)	613 (3.5)	8 (2.3)	609 (10.2)
Kuwait	r 1 (0.6)	~ ~	8 (2.2)	392 (8.6)	52 (5.0)	395 (3.6)	39 (4.8)	409 (5.8)
Latvia (LSS)	- -	- -	- -	- -	- -	- -	- -	- -
Netherlands	0 (0.0)	~ ~	6 (2.2)	570 (12.2)	53 (4.5)	578 (5.4)	41 (4.5)	578 (5.2)
New Zealand	2 (1.6)	~ ~	33 (4.3)	504 (7.3)	37 (4.5)	505 (7.2)	27 (3.7)	499 (9.6)
Norway	0 (0.0)	~ ~	22 (4.4)	503 (6.2)	59 (5.0)	504 (4.2)	18 (4.1)	492 (5.9)
Portugal	7 (2.2)	464 (17.7)	29 (4.3)	470 (8.7)	49 (4.9)	480 (4.8)	14 (3.2)	482 (13.1)
Scotland	- -	- -	- -	- -	- -	- -	- -	- -
Singapore	5 (1.8)	622 (15.6)	28 (2.8)	625 (8.4)	45 (3.9)	618 (6.5)	22 (3.4)	647 (12.8)
Slovenia	1 (0.9)	~ ~	1 (0.7)	~ ~	62 (5.1)	551 (4.2)	36 (5.2)	549 (7.0)
Thailand	r 1 (0.5)	~ ~	23 (5.3)	476 (13.1)	24 (4.4)	492 (7.6)	53 (5.9)	500 (8.2)
United States	r 2 (1.1)	~ ~	26 (3.4)	550 (5.6)	50 (4.2)	547 (4.1)	22 (4.2)	544 (7.9)

*Fourth grade in most countries: see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.
An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

The types of activities teachers asked fourth-grade students to do, however, varied from country to country. Teachers were asked how often they had students practice computational skills, and the responses are shown in Table 5.10. It appears that in most countries, the majority of the students practice computation in most all lessons. In most countries, there was no relationship between the frequency with which teachers asked students to practice computation and average mathematics achievement. However, in several countries, students who practiced more frequently had higher achievement and, in several other countries, they had lower achievement.

The data in Table 5.11 reveal that the majority of students in most countries were asked to do some type of mathematics reasoning task in most or all lessons. The activities TIMSS asked about included explaining the reasoning behind an idea; using tables, charts, or graphs to represent and analyze relationships; working on problems for which there is no immediately obvious solution; and writing equations to represent relationships. In Japan, 45% or more of the students were asked to do at least one of these types of reasoning task in every lesson. In about one-third of the countries, students who were asked to do reasoning tasks in every lesson had higher average mathematics achievement than those asked to do reasoning tasks in only some lessons. This indicates that sometimes the better-performing students are asked to do more reasoning in their lessons, when in actuality students at all levels of performance need opportunities to reason mathematically. In most countries, however, there was little relationship between frequency of students being asked to do reasoning tasks and average mathematics achievement.

Teachers were not asked about the emphasis placed on using things from everyday life in solving mathematics problems, but students were (see Table 5.12). According to fourth-grade students, such mathematics problems typically are done in some lessons rather than most lessons, although in many countries about one-fourth to one-third of the students reported this activity in every lesson. Across countries, relatively small percentages of students (about one-third or fewer) reported never being asked to do these types of problems. The relationship between average mathematics achievement and being asked to do these types of problems was inconsistent across countries.

Table 5.11

Teachers' Reports on How Often They Ask Students to Do Reasoning Tasks[1] Mathematics - Upper Grade (Fourth Grade*)

Country	Never or Almost Never		Some Lessons		Most Lessons		Every Lesson	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	r 1 (1.2)	~ ~	35 (3.9)	539 (7.8)	54 (3.8)	549 (4.6)	10 (2.4)	552 (10.0)
Austria	0 (0.4)	~ ~	17 (3.2)	571 (9.4)	61 (4.3)	558 (4.3)	22 (3.2)	558 (7.1)
Canada	0 (0.0)	~ ~	32 (3.8)	534 (6.2)	49 (4.0)	529 (4.3)	19 (3.1)	540 (10.5)
Cyprus	s 0 (0.0)	~ ~	4 (1.9)	479 (9.6)	64 (6.2)	504 (5.6)	32 (6.0)	512 (7.6)
Czech Republic	0 (0.0)	~ ~	5 (1.7)	548 (14.7)	63 (3.9)	565 (3.8)	32 (3.9)	575 (7.2)
England	- -	- -	- -	- -	- -	- -	- -	- -
Greece	0 (0.5)	~ ~	22 (3.7)	507 (11.6)	43 (4.1)	495 (5.5)	34 (4.0)	487 (6.3)
Hong Kong	6 (2.9)	584 (9.8)	73 (5.1)	586 (4.6)	19 (4.4)	598 (12.0)	2 (1.3)	~ ~
Hungary	0 (0.0)	~ ~	7 (2.5)	548 (13.5)	65 (4.4)	544 (4.5)	28 (4.0)	561 (6.7)
Iceland	3 (1.7)	471 (13.4)	71 (5.0)	478 (3.5)	23 (4.4)	464 (4.8)	2 (2.0)	~ ~
Iran, Islamic Rep.	0 (0.0)	~ ~	31 (4.4)	438 (9.3)	57 (4.9)	426 (5.6)	12 (2.6)	418 (5.2)
Ireland	1 (1.1)	~ ~	33 (4.5)	545 (5.6)	47 (4.4)	548 (5.4)	19 (3.9)	564 (7.4)
Israel	x x	x x	x x	x x	x x	x x	x x	x x
Japan	0 (0.0)	~ ~	10 (2.7)	593 (4.5)	46 (4.1)	596 (3.1)	45 (4.1)	599 (3.2)
Korea	0 (0.0)	~ ~	16 (3.1)	608 (6.1)	53 (4.1)	610 (3.0)	31 (3.9)	613 (4.4)
Kuwait	r 5 (2.3)	402 (8.7)	51 (4.9)	396 (4.4)	36 (4.3)	402 (5.7)	7 (2.4)	430 (14.1)
Latvia (LSS)	0 (0.4)	~ ~	21 (3.6)	529 (14.7)	59 (4.6)	524 (5.8)	20 (3.7)	522 (11.1)
Netherlands	0 (0.0)	~ ~	15 (3.2)	568 (9.9)	70 (4.5)	577 (4.3)	14 (3.1)	583 (7.5)
New Zealand	0 (0.0)	~ ~	21 (3.7)	502 (9.9)	61 (4.6)	500 (5.8)	18 (3.5)	513 (8.7)
Norway	1 (0.8)	~ ~	50 (4.8)	504 (4.1)	36 (4.4)	498 (5.5)	12 (3.3)	507 (9.3)
Portugal	0 (0.0)	~ ~	16 (3.4)	472 (10.3)	62 (4.0)	471 (5.0)	22 (3.6)	491 (8.6)
Scotland	- -	- -	- -	- -	- -	- -	- -	- -
Singapore	3 (1.5)	605 (4.8)	28 (4.0)	622 (9.2)	52 (3.8)	623 (7.1)	17 (2.9)	644 (12.3)
Slovenia	0 (0.0)	~ ~	18 (3.9)	550 (5.5)	68 (4.5)	548 (4.4)	14 (3.3)	563 (6.7)
Thailand	2 (2.4)	~ ~	34 (5.6)	483 (10.3)	47 (6.4)	499 (8.9)	16 (4.3)	484 (10.0)
United States	r 0 (0.0)	~ ~	26 (3.8)	543 (4.7)	54 (3.8)	549 (4.2)	20 (2.6)	547 (7.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Based on most frequent response for: explain reasoning behind an idea; represent and analyze relationships using tables, charts or graphs; work on problems for which there is no immediately obvious method of solution; and write equations to represent relationships.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.12

Students' Reports on Using Things from Everyday Life in Solving Mathematics Problems - Upper Grade (Fourth Grade*)

Country	Never		Some Lessons		Most Lessons	
	Percent of Students	**Mean Achievement**	**Percent of Students**	**Mean Achievement**	**Percent of Students**	**Mean Achievement**
Australia	12 (0.7)	544 (4.4)	65 (1.0)	553 (4.0)	24 (0.8)	544 (4.2)
Austria	23 (1.3)	564 (4.2)	57 (1.8)	563 (3.7)	20 (1.2)	551 (5.9)
Canada	17 (1.5)	531 (4.6)	59 (1.8)	539 (4.3)	24 (1.0)	526 (4.4)
Cyprus	22 (1.4)	506 (4.4)	44 (2.1)	515 (3.7)	34 (2.1)	497 (4.7)
Czech Republic	16 (1.3)	558 (5.1)	53 (2.4)	573 (3.6)	31 (2.5)	567 (5.3)
England	31 (1.8)	511 (4.9)	59 (1.7)	526 (3.9)	11 (0.6)	472 (5.4)
Greece	27 (1.3)	503 (4.3)	38 (1.5)	505 (4.4)	34 (1.7)	487 (5.1)
Hong Kong	27 (1.5)	579 (5.5)	56 (1.9)	598 (4.2)	17 (2.3)	569 (5.3)
Hungary	31 (1.1)	571 (4.6)	49 (1.1)	552 (4.2)	20 (1.1)	517 (4.9)
Iceland	34 (1.8)	490 (2.9)	50 (1.9)	478 (3.8)	16 (1.2)	447 (4.3)
Iran, Islamic Rep.	r 7 (1.0)	446 (7.4)	24 (1.6)	441 (5.3)	69 (1.7)	435 (5.0)
Ireland	27 (1.4)	559 (4.3)	51 (1.4)	560 (3.4)	22 (1.4)	525 (5.6)
Israel	r 18 (1.1)	540 (6.4)	49 (1.6)	533 (4.0)	34 (1.6)	532 (4.6)
Japan	20 (0.9)	598 (2.8)	71 (1.2)	598 (2.3)	9 (1.0)	589 (4.8)
Korea	19 (0.8)	602 (3.5)	52 (1.0)	616 (2.3)	29 (0.9)	612 (3.3)
Kuwait	13 (0.9)	409 (3.9)	47 (2.3)	407 (2.8)	40 (2.3)	394 (4.1)
Latvia (LSS)	10 (0.8)	502 (7.5)	43 (2.1)	535 (7.9)	47 (2.0)	528 (4.4)
Netherlands	31 (1.8)	581 (5.7)	59 (2.2)	582 (3.7)	11 (1.3)	570 (7.5)
New Zealand	11 (0.9)	487 (8.6)	61 (1.3)	512 (4.3)	28 (1.2)	485 (6.0)
Norway	32 (1.3)	512 (3.3)	54 (1.3)	514 (3.0)	14 (1.1)	476 (6.4)
Portugal	10 (0.9)	480 (5.4)	50 (2.2)	491 (3.6)	40 (2.0)	463 (5.0)
Scotland	11 (1.0)	523 (6.9)	67 (1.6)	529 (4.4)	22 (1.4)	507 (5.4)
Singapore	17 (1.0)	639 (8.1)	56 (1.7)	631 (5.2)	27 (1.6)	614 (6.8)
Slovenia	14 (1.3)	554 (6.8)	58 (1.7)	559 (3.6)	28 (1.6)	541 (4.3)
Thailand	28 (1.3)	492 (3.6)	52 (1.3)	496 (5.1)	20 (1.2)	467 (6.6)
United States	15 (0.7)	539 (3.7)	50 (0.7)	557 (3.2)	35 (0.9)	535 (3.4)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

HOW ARE CALCULATORS AND COMPUTERS USED?

As shown in Table 5.13, nearly all fourth-grade students reported having a calculator in the home, except in Greece (61%), Iran (49%), Israel (43%), and Thailand (43%). Internationally, fewer students reported a computer in the home, even though more than three-fourths did so in England, Iceland, Ireland, the Netherlands, and Scotland. Between 50% and 75% so reported in Australia, Austria, Canada, Israel, Kuwait, New Zealand, Norway, and the United States. Fewer than 10% of the fourth-grade students reported home computers in Iran and Thailand.

Table 5.14 provides teachers' reports about how often calculators are used in fourth-grade mathematics classes. Even though calculators appear to be widely available in most countries, teachers reported considerable variation from country to country in the frequency of calculator use in mathematics classrooms. Using calculators can take the drudgery out of mathematics and free the learner to concentrate on higher-order problem-solving skills. However, another point of view, especially at the primary grades, is that permitting unrestricted use of calculators may damage students' mastery of basic skills in mathematics. For example, even though calculators are quite widespread in Korea they generally are forbidden for use in mathematics classes.[1]

According to teachers in many of the TIMSS countries, most fourth-grade students never or hardly ever use calculators in their mathematics classes. The exceptions, where there is at least weekly use of calculators for the majority of the students, include Australia, England, and New Zealand. Moderate use (monthly or weekly) also was reported in Canada and the United States for the majority of the students. As revealed in Table 5.15, when calculators were used, teachers reported that students used them for a variety of purposes. Across the countries with at least moderate calculator use, no single use seemed to predominate, although checking answers appeared to be a relatively frequent purpose, and using calculators on tests and exams was often less frequent than other uses.

Students' reports about the frequency of calculator use in mathematics classes are presented in Table 5.16. Because different response categories were used for the student and teacher versions of the question, a direct comparison is difficult. However, comparing the least frequent and most frequent columns yields a fair degree of agreement between teachers' and students' reports.

Table 5.17 contains teachers' reports about how often computers are used in mathematics class to solve exercises or problems, and Table 5.18 contains students' responses to a similar question. In about half the countries, substantial percentages of teachers and students agreed that the computer is almost never used in most students' mathematics lessons. Teachers and students agreed on moderate use of computers (more than 30% of the students in at least some lessons) in Australia, Canada, the Netherlands, New Zealand, Singapore, and the United States. Even though teacher data are not available, students in England, Israel, and Scotland also reported moderate use of computers.

Robitaille, D.F. (Ed.). (1997). *National Contexts for Mathematics and Science Education: An Encyclopedia of the Education Systems Participating in TIMSS.* Vancouver, B.C.: Pacific Educational Press.

Table 5.13

Students' Reports on Having a Calculator and Computer in the Home Mathematics - Upper Grade (Fourth Grade*)

Country	Calculator				Computer			
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	88 (0.8)	555 (3.1)	12 (0.8)	485 (6.1)	63 (1.1)	[illegible]	[illegible]	[illegible]
Austria	91 (0.7)	563 (2.9)	9 (0.7)	520 (10.0)	61 (1.5)	558 (3.3)	39 (1.5)	562 (4.4)
Canada	87 (0.7)	540 (3.2)	13 (0.7)	476 (4.5)	52 (1.1)	546 (3.5)	48 (1.1)	516 (4.4)
Cyprus	82 (1.1)	512 (3.0)	18 (1.1)	471 (5.2)	35 (1.0)	511 (4.2)	65 (1.0)	502 (3.4)
Czech Republic	95 (0.5)	569 (3.3)	5 (0.5)	534 (6.9)	33 (1.3)	582 (4.6)	67 (1.3)	561 (3.2)
England	93 (0.6)	518 (3.3)	7 (0.6)	447 (6.2)	88 (0.9)	513 (3.5)	12 (0.9)	512 (5.4)
Greece	61 (1.1)	505 (3.8)	39 (1.1)	480 (5.0)	23 (1.1)	500 (4.5)	77 (1.1)	495 (4.3)
Hong Kong	92 (0.6)	589 (4.2)	8 (0.6)	558 (9.1)	37 (1.2)	594 (5.2)	63 (1.2)	583 (4.3)
Hungary	88 (0.9)	557 (3.6)	12 (0.9)	498 (6.4)	37 (1.4)	569 (5.5)	63 (1.4)	538 (3.4)
Iceland	84 (1.3)	485 (3.0)	16 (1.3)	432 (4.2)	81 (1.1)	478 (3.0)	19 (1.1)	464 (3.6)
Iran, Islamic Rep.	r 49 (1.7)	451 (5.3)	52 (1.7)	420 (3.9)	r 8 (0.8)	428 (7.4)	92 (0.8)	435 (4.2)
Ireland	86 (0.8)	557 (3.1)	14 (0.8)	512 (6.8)	79 (0.9)	553 (3.4)	21 (0.9)	542 (5.4)
Israel	r 43 (1.5)	543 (5.0)	57 (1.5)	527 (3.8)	r 70 (1.9)	540 (3.8)	30 (1.9)	521 (5.2)
Japan	- -	- -	- -	- -	- -	- -	- -	- -
Korea	87 (0.8)	613 (2.2)	13 (0.8)	593 (4.5)	23 (1.0)	628 (4.2)	77 (1.0)	606 (2.2)
Kuwait	75 (1.0)	404 (3.2)	25 (1.0)	393 (2.4)	66 (1.3)	405 (3.0)	34 (1.3)	395 (2.8)
Latvia (LSS)	78 (1.4)	529 (5.0)	22 (1.4)	515 (6.1)	21 (1.3)	517 (5.9)	79 (1.3)	528 (5.3)
Netherlands	93 (0.7)	582 (3.5)	7 (0.7)	545 (6.0)	80 (1.2)	585 (3.7)	20 (1.2)	560 (4.3)
New Zealand	90 (1.0)	508 (3.8)	10 (1.0)	428 (7.4)	53 (1.5)	517 (4.1)	47 (1.5)	479 (5.1)
Norway	76 (1.3)	510 (3.2)	24 (1.3)	480 (4.0)	56 (1.3)	511 (3.5)	44 (1.3)	492 (3.5)
Portugal	83 (1.2)	484 (3.1)	17 (1.2)	434 (6.4)	34 (1.7)	495 (4.0)	66 (1.7)	467 (4.2)
Scotland	90 (0.7)	528 (3.8)	10 (0.7)	467 (5.6)	89 (0.6)	523 (4.0)	11 (0.6)	511 (6.0)
Singapore	93 (0.4)	633 (5.3)	7 (0.4)	528 (6.6)	44 (1.3)	649 (6.1)	56 (1.3)	607 (4.8)
Slovenia	78 (1.7)	564 (3.2)	22 (1.7)	517 (4.7)	43 (1.3)	560 (4.0)	57 (1.3)	547 (3.4)
Thailand	43 (2.4)	506 (4.6)	57 (2.4)	476 (4.8)	3 (0.6)	488 (22.8)	97 (0.6)	489 (4.3)
United States	95 (0.5)	549 (2.9)	5 (0.5)	475 (6.5)	56 (1.6)	559 (3.1)	44 (1.6)	528 (3.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.14

Teachers' Reports on Frequency of Students' Use of Calculators in Mathematics Class[1] – Upper Grade (Fourth Grade*)

Country		Never or Hardly Ever		Once or Twice a Month		Once or Twice a Week		Almost Every Day	
		Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	r	11 (2.6)	547 (8.9)	33 (3.6)	535 (7.0)	43 (3.9)	557 (4.8)	13 (2.5)	536 (10.3)
Austria		98 (1.7)	560 (3.5)	1 (1.1)	~ ~	1 (1.4)	~ ~	0 (0.0)	~ ~
Canada		37 (3.4)	534 (4.2)	35 (3.0)	527 (6.0)	25 (4.2)	539 (9.1)	4 (1.1)	536 (11.9)
Cyprus	s	63 (6.1)	506 (5.5)	11 (4.2)	502 (13.0)	15 (4.2)	524 (9.9)	11 (4.2)	489 (22.5)
Czech Republic		54 (4.3)	570 (5.0)	25 (3.8)	566 (6.1)	17 (3.4)	562 (8.2)	4 (1.7)	559 (7.5)
England		8 (2.3)	511 (11.2)	39 (4.6)	520 (7.3)	42 (5.2)	513 (5.4)	11 (3.1)	508 (15.0)
Greece		94 (2.1)	497 (3.5)	2 (1.1)	~ ~	3 (1.4)	521 (35.6)	2 (1.1)	~ ~
Hong Kong		95 (2.2)	589 (4.2)	1 (1.0)	~ ~	2 (1.3)	~ ~	1 (1.4)	~ ~
Hungary	s	78 (5.3)	552 (5.5)	9 (3.3)	546 (16.6)	2 (1.3)	~ ~	12 (4.1)	562 (14.8)
Iceland		65 (5.7)	472 (3.5)	17 (4.3)	482 (6.9)	16 (4.6)	480 (6.6)	2 (1.5)	~ ~
Iran, Islamic Rep.		76 (4.2)	426 (4.7)	14 (3.6)	443 (12.9)	7 (2.7)	429 (8.1)	3 (1.5)	418 (20.0)
Ireland		88 (2.8)	552 (3.8)	5 (1.8)	549 (20.4)	4 (1.7)	552 (21.0)	3 (1.3)	508 (9.5)
Israel		x x	x x	x x	x x	x x	x x	x x	x x
Japan		94 (2.0)	597 (2.2)	5 (2.0)	590 (6.6)	1 (0.6)	~ ~	0 (0.0)	~ ~
Korea		86 (3.1)	611 (2.3)	8 (2.6)	608 (6.5)	4 (1.6)	613 (20.5)	2 (1.2)	~ ~
Kuwait	r	75 (3.7)	405 (3.4)	8 (2.8)	400 (14.7)	13 (3.3)	378 (11.7)	4 (2.2)	385 (3.9)
Latvia (LSS)	r	91 (3.1)	525 (5.9)	6 (2.6)	548 (36.0)	2 (1.5)	~ ~	1 (0.8)	~ ~
Netherlands		85 (3.1)	576 (4.0)	11 (2.8)	594 (7.3)	2 (1.2)	~ ~	2 (1.4)	~ ~
New Zealand		5 (1.9)	466 (24.0)	22 (3.1)	502 (9.3)	42 (4.1)	504 (5.9)	30 (4.1)	500 (8.9)
Norway		93 (2.6)	502 (3.3)	7 (2.5)	494 (11.4)	1 (0.8)	~ ~	0 (0.0)	~ ~
Portugal		58 (4.3)	474 (4.7)	13 (2.8)	473 (13.1)	7 (2.3)	497 (14.5)	22 (3.8)	473 (9.7)
Scotland		- -	- -	- -	- -	- -	- -	- -	- -
Singapore		97 (1.3)	626 (5.5)	2 (1.1)	~ ~	1 (0.9)	~ ~	0 (0.0)	~ ~
Slovenia		88 (3.2)	549 (3.7)	8 (2.7)	560 (12.5)	4 (2.0)	547 (27.0)	1 (0.8)	~ ~
Thailand	r	93 (3.3)	492 (5.9)	0 (0.0)	~ ~	3 (1.2)	483 (20.3)	4 (3.1)	457 (41.8)
United States	r	29 (4.4)	539 (7.2)	32 (3.1)	541 (5.1)	28 (3.5)	553 (5.5)	11 (2.3)	575 (7.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Based on most frequent response for: checking answers, tests and exams, routine computations, solving complex problems, and exploring number concepts.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.15

Teachers' Reports on Ways in Which Calculators Are Used at Least Once or Twice a Week - Mathematics - Upper Grade (Fourth Grade*)

Country	Percent of Students by Type of Use					
	Never or Hardly Ever Use Calculators	Checking Answers	Tests and Exams	Routine Computations	Solving Complex Problems	Exploring Number Concepts
Australia	r 11 (2.6)	r 45 (3.4)	r 2 (1.1)	r 29 (3.6)	r 35 (3.5)	r 33 (4.0)
Austria	98 (1.7)	1 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Canada	37 (3.4)	16 (3.3)	1 (0.4)	15 (3.5)	23 (4.0)	14 (2.4)
Cyprus	s 63 (6.1)	s 18 (5.0)	s 1 (0.5)	s 16 (4.8)	s 13 (4.6)	s 7 (3.1)
Czech Republic	54 (4.3)	18 (3.3)	2 (1.1)	4 (1.6)	8 (2.4)	3 (1.6)
England	8 (2.3)	36 (4.2)	r 4 (2.1)	33 (4.7)	28 (4.2)	24 (3.9)
Greece	94 (2.1)	3 (1.5)	r 1 (0.7)	r 2 (1.1)	r 2 (1.2)	2 (1.1)
Hong Kong	95 (2.2)	4 (2.0)	0 (0.0)	2 (1.7)	2 (1.7)	1 (1.4)
Hungary	s 78 (5.3)	s 13 (4.3)	x x	s 8 (3.9)	s 5 (3.2)	s 8 (3.7)
Iceland	65 (5.7)	12 (4.3)	0 (0.0)	5 (2.4)	4 (2.1)	6 (2.9)
Iran, Islamic Rep.	76 (4.2)	1 (0.4)	4 (2.2)	5 (2.0)	5 (2.3)	5 (2.3)
Ireland	88 (2.8)	6 (2.1)	0 (0.0)	3 (1.4)	3 (1.1)	3 (1.4)
Israel	x x	x x	x x	x x	x x	x x
Japan	94 (2.0)	1 (0.6)	1 (0.6)	1 (0.6)	1 (0.6)	0 (0.0)
Korea	86 (3.1)	1 (0.9)	1 (0.9)	6 (2.0)	3 (1.5)	1 (0.9)
Kuwait	r 75 (3.7)	r 7 (2.4)	r 0 (0.0)	r 9 (3.1)	r 7 (2.7)	r 6 (2.4)
Latvia (LSS)	r 91 (3.1)	r 2 (1.4)	r 1 (1.2)	r 1 (1.2)	r 3 (1.7)	r 2 (1.4)
Netherlands	85 (3.1)	2 (1.3)	0 (0.0)	2 (1.3)	2 (1.3)	1 (0.9)
New Zealand	5 (1.9)	61 (3.5)	7 (2.6)	50 (4.1)	50 (4.0)	49 (3.9)
Norway	93 (2.6)	1 (0.8)	0 (0.0)	1 (0.8)	1 (0.8)	1 (0.8)
Portugal	58 (4.3)	27 (3.9)	2 (1.1)	17 (3.2)	11 (2.9)	10 (2.8)
Scotland	- -	- -	- -	- -	- -	- -
Singapore	97 (1.3)	0 (0.0)	0 (0.0)	0 (0.5)	1 (0.9)	0 (0.0)
Slovenia	88 (3.2)	4 (2.0)	0 (0.0)	2 (1.1)	0 (0.0)	0 (0.0)
Thailand	r 93 (3.3)	r 5 (3.2)	r 2 (1.1)	r 5 (3.1)	r 4 (3.1)	r 5 (3.2)
United States	r 29 (4.4)	r 25 (3.5)	r 2 (0.6)	r 24 (3.8)	r 26 (4.6)	r 21 (3.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (-) indicates data are not available.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.
An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.16

Students' Reports on Frequency of Using Calculators in Mathematics Class Upper Grade (Fourth Grade*)

Country	Never		Some Lessons		Most Lessons	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	25 (2.6)	545 (4.1)	67 (2.4)	556 (3.9)	8 (0.6)	512 (4.6)
Austria	96 (0.6)	563 (3.1)	2 (0.5)	~ ~	1 (0.3)	~ ~
Canada	51 (3.1)	532 (3.7)	43 (3.0)	546 (4.9)	6 (0.8)	493 (7.4)
Cyprus	86 (1.6)	514 (2.9)	9 (1.4)	478 (8.3)	4 (0.4)	431 (8.5)
Czech Republic	63 (3.3)	571 (4.2)	32 (3.1)	568 (4.0)	4 (0.8)	529 (10.0)
England	15 (1.8)	510 (7.0)	74 (1.8)	524 (3.9)	11 (1.1)	474 (6.2)
Greece	91 (0.9)	504 (3.3)	6 (0.6)	449 (11.1)	4 (0.6)	425 (15.2)
Hong Kong	95 (0.7)	593 (4.0)	3 (0.5)	492 (7.5)	2 (0.3)	~ ~
Hungary	90 (1.3)	553 (3.6)	7 (1.2)	549 (13.4)	3 (0.5)	476 (11.1)
Iceland	76 (3.2)	480 (2.5)	21 (3.0)	478 (7.4)	3 (0.6)	430 (7.4)
Iran, Islamic Rep.	r 64 (2.2)	450 (5.3)	15 (1.3)	415 (5.2)	21 (1.6)	413 (4.4)
Ireland	91 (1.0)	557 (3.4)	6 (0.8)	516 (10.5)	3 (0.3)	480 (12.0)
Israel	r 24 (2.6)	522 (5.1)	60 (2.3)	541 (4.2)	16 (1.5)	525 (6.8)
Japan	89 (0.9)	602 (2.0)	11 (0.9)	561 (4.2)	1 (0.1)	~ ~
Korea	93 (0.5)	616 (2.0)	5 (0.4)	579 (7.2)	2 (0.3)	~ ~
Kuwait	73 (1.4)	412 (2.3)	12 (0.8)	383 (4.4)	15 (1.0)	374 (4.1)
Latvia (LSS)	83 (1.8)	533 (5.3)	13 (1.5)	513 (9.0)	4 (0.6)	469 (9.3)
Netherlands	90 (2.1)	579 (3.5)	10 (2.1)	592 (8.1)	0 (0.2)	~ ~
New Zealand	18 (2.0)	495 (6.4)	61 (1.8)	512 (4.2)	21 (1.3)	475 (8.0)
Norway	89 (1.5)	510 (2.8)	8 (1.3)	498 (8.3)	3 (0.5)	429 (12.6)
Portugal	73 (3.1)	482 (3.0)	20 (2.5)	487 (9.3)	8 (1.0)	440 (8.3)
Scotland	5 (0.6)	489 (7.6)	82 (1.3)	533 (3.7)	13 (1.1)	469 (5.9)
Singapore	96 (0.4)	634 (5.2)	3 (0.3)	511 (9.0)	1 (0.2)	~ ~
Slovenia	92 (0.9)	559 (3.2)	6 (0.9)	497 (9.0)	2 (0.3)	~ ~
Thailand	82 (1.5)	498 (4.4)	13 (1.1)	458 (5.5)	5 (0.7)	428 (6.9)
United States	34 (3.7)	534 (4.9)	53 (3.2)	565 (3.4)	13 (1.1)	507 (6.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.17

Teachers' Reports on Frequency of Using Computers in Mathematics Class to Solve Exercises or Problems - Upper Grade (Fourth Grade*)

Country		Never or Almost Never		Some Lessons		Most or Every Lesson	
		Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	r	66 (4.5)	548 (5.3)	33 (4.6)	542 (7.2)	1 (0.8)	~ ~
Austria		98 (1.6)	560 (3.5)	2 (1.6)	~ ~	0 (0.0)	~ ~
Canada		58 (4.0)	540 (4.5)	40 (4.0)	522 (6.3)	2 (1.2)	~ ~
Cyprus	s	86 (5.1)	508 (4.2)	14 (5.1)	494 (21.8)	1 (0.6)	~ ~
Czech Republic		97 (1.7)	568 (3.3)	3 (1.7)	561 (20.7)	0 (0.0)	~ ~
England		- -	- -	- -	- -	- -	- -
Greece		99 (1.4)	495 (4.1)	1 (1.4)	~ ~	0 (0.0)	~ ~
Hong Kong		99 (0.8)	589 (4.3)	1 (0.8)	~ ~	0 (0.0)	~ ~
Hungary		- -	- -	- -	- -	- -	- -
Iceland		- -	- -	- -	- -	- -	- -
Iran, Islamic Rep.		99 (1.1)	428 (4.1)	0 (0.5)	~ ~	1 (1.0)	~ ~
Ireland		90 (3.2)	549 (3.7)	10 (3.2)	570 (10.8)	0 (0.0)	~ ~
Israel		- -	- -	- -	- -	- -	- -
Japan		93 (2.3)	598 (2.1)	5 (2.0)	590 (7.8)	2 (1.2)	~ ~
Korea		96 (1.7)	610 (2.2)	4 (1.5)	616 (8.2)	1 (0.6)	~ ~
Kuwait	r	98 (1.3)	401 (3.4)	2 (1.3)	~ ~	0 (0.0)	~ ~
Latvia (LSS)		95 (2.0)	522 (5.0)	3 (1.5)	534 (10.5)	2 (1.3)	~ ~
Netherlands		65 (5.0)	581 (4.9)	33 (4.7)	570 (4.9)	2 (1.3)	~ ~
New Zealand		69 (3.8)	499 (4.6)	30 (3.7)	512 (10.1)	1 (0.8)	~ ~
Norway		80 (3.7)	502 (3.6)	20 (3.7)	499 (6.4)	1 (0.7)	~ ~
Portugal		98 (1.2)	475 (3.7)	2 (1.2)	~ ~	0 (0.0)	~ ~
Scotland		- -	- -	- -	- -	- -	- -
Singapore		66 (4.2)	627 (5.7)	33 (4.2)	621 (9.8)	1 (0.7)	~ ~
Slovenia		92 (2.8)	549 (3.5)	6 (2.5)	565 (22.8)	2 (1.3)	~ ~
Thailand	r	96 (2.6)	491 (5.3)	1 (0.7)	~ ~	3 (2.5)	547 (61.2)
United States	r	60 (4.1)	546 (4.7)	37 (4.2)	551 (4.2)	3 (1.0)	532 (12.2)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.18

Students' Reports on Frequency of Using Computers in Mathematics Class Upper Grade (Fourth Grade*)

Country	Never		Some Lessons		Most Lessons	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	56 (2.1)	564 (2.9)	37 (1.9)	538 (4.8)	7 (0.8)	502 (11.9)
Austria	97 (0.6)	562 (3.2)	3 (0.6)	514 (18.6)	1 (0.2)	~ ~
Canada	62 (2.3)	546 (4.0)	30 (2.0)	528 (4.7)	8 (0.8)	474 (7.6)
Cyprus	87 (1.7)	513 (2.9)	8 (1.6)	483 (11.2)	5 (0.5)	439 (7.3)
Czech Republic	93 (1.4)	570 (3.3)	6 (1.3)	561 (12.1)	1 (0.2)	~ ~
England	40 (2.3)	531 (5.5)	51 (2.1)	516 (3.8)	9 (0.9)	457 (5.3)
Greece	91 (0.9)	505 (3.3)	5 (0.5)	453 (8.5)	4 (0.5)	401 (10.9)
Hong Kong	95 (0.9)	593 (4.1)	3 (0.7)	516 (25.0)	2 (0.3)	~ ~
Hungary	92 (0.8)	554 (3.6)	6 (0.6)	523 (10.9)	3 (0.4)	469 (9.2)
Iceland	80 (2.1)	481 (2.9)	17 (2.0)	472 (5.3)	3 (0.5)	421 (6.8)
Iran, Islamic Rep.	r 74 (1.8)	446 (5.1)	11 (1.0)	409 (5.3)	14 (1.3)	412 (4.1)
Ireland	83 (2.4)	559 (3.3)	12 (2.0)	536 (8.8)	4 (0.8)	484 (13.6)
Israel	r 41 (3.4)	542 (5.1)	38 (2.6)	536 (4.7)	21 (2.0)	514 (5.8)
Japan	90 (1.7)	601 (2.1)	10 (1.8)	572 (7.5)	1 (0.1)	~ ~
Korea	92 (0.9)	615 (2.1)	6 (0.8)	589 (6.4)	2 (0.4)	~ ~
Kuwait	74 (1.6)	412 (2.4)	11 (0.9)	381 (3.9)	15 (1.1)	375 (3.8)
Latvia (LSS)	93 (0.8)	532 (5.1)	4 (0.6)	498 (7.8)	3 (0.5)	443 (8.0)
Netherlands	51 (3.7)	581 (4.7)	45 (3.5)	581 (3.6)	4 (0.9)	555 (10.6)
New Zealand	61 (2.2)	516 (4.3)	29 (1.9)	496 (6.2)	11 (1.0)	432 (7.5)
Norway	71 (3.1)	511 (3.2)	25 (2.8)	505 (4.6)	4 (0.8)	467 (16.5)
Portugal	92 (0.9)	484 (3.1)	5 (0.8)	455 (11.2)	3 (0.4)	392 (10.7)
Scotland	33 (1.8)	544 (4.7)	58 (1.9)	522 (4.4)	9 (1.2)	458 (6.1)
Singapore	60 (3.3)	636 (6.0)	35 (3.0)	621 (7.5)	4 (0.6)	559 (23.5)
Slovenia	93 (0.9)	558 (3.2)	5 (0.8)	503 (9.5)	2 (0.3)	~ ~
Thailand	88 (1.3)	495 (4.2)	8 (0.9)	450 (7.9)	4 (0.5)	435 (7.0)
United States	59 (2.5)	555 (2.9)	28 (2.0)	552 (6.1)	13 (1.1)	501 (6.7)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

WHAT HOMEWORK ARE STUDENTS ASSIGNED?

Although teachers often give students time to begin or review homework assignments in class, homework is generally considered a method of extending the time spent on regular classroom lessons. Table 5.19 presents teachers' reports about how often they assigned homework and the typical lengths of such assignments. Internationally, most fourth-grade students were assigned homework at least once or twice a week, if not three times a week or more often. The pattern for the Netherlands differed substantially from other countries, with teachers reporting that 86% of the students were assigned homework less than once a week, and of those, half were never assigned homework. Typically, for the majority of students the assignments were 30 minutes or less in length. Homework assignments were more than 30 minutes for about one-third of students or more in Hong Kong, Iran, Korea, Singapore, and Thailand.

Homework generally has its biggest impact when it is commented on and graded by teachers. Table 5.20 presents teachers' reports about their use of students' written mathematics homework. In all participating countries, for at least 70% of the students, teachers reported at least sometimes, if not always, correcting homework assignments and returning those assignments to students.

Many teachers do not count mathematics homework directly in determining grades, but use it more as a method to monitor students' understanding and to correct misconceptions. In general, for the TIMSS countries, teachers reported that mathematics homework assignments contributed only rarely or sometimes to students' grades or marks. In some countries, homework had even less impact on grades. According to their teachers, homework never or only rarely contributed to the grades for the majority of the students in the Czech Republic, Hong Kong, Japan, and Singapore.

Table 5.19

Teachers' Reports About the Amount of Mathematics Homework Assigned Upper Grade (Fourth Grade*)

Country	Never Assigning Homework	Assigning Homework Less Than Once a Week		Assigning Homework Once or Twice a Week		Assigning Homework Three Times a Week or More Often	
		30 Minutes or Less	More Than 30 Minutes	30 Minutes or Less	More Than 30 Minutes	30 Minutes or Less	More Than 30 Minutes
Australia	r 4 (1.5)	13 (2.8)	2 (1.6)	50 (4.0)	5 (1.9)	25 (3.9)	2 (0.9)
Austria	1 (1.4)	0 (0.0)	0 (0.0)	19 (3.3)	0 (0.0)	67 (4.5)	13 (3.4)
Canada	14 (2.1)	9 (2.4)	0 (0.4)	45 (3.7)	0 (0.3)	29 (3.9)	1 (0.6)
Cyprus	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.4)	0 (0.0)	83 (5.0)	16 (4.8)
Czech Republic	0 (0.0)	6 (1.9)	0 (0.0)	66 (3.6)	0 (0.0)	29 (3.6)	0 (0.0)
England	- -	- -	- -	- -	- -	- -	- -
Greece	0 (0.0)	2 (1.0)	0 (0.0)	22 (3.3)	5 (2.2)	61 (4.1)	10 (2.7)
Hong Kong	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	63 (5.3)	37 (5.3)
Hungary	0 (0.0)	1 (0.8)	0 (0.0)	1 (0.9)	1 (0.5)	93 (2.5)	4 (2.1)
Iceland	0 (0.0)	3 (1.6)	0 (0.0)	42 (7.2)	10 (3.6)	45 (6.6)	1 (0.1)
Iran, Islamic Rep.	0 (0.0)	2 (1.0)	0 (0.1)	11 (2.8)	6 (2.1)	51 (4.3)	30 (4.1)
Ireland	0 (0.0)	0 (0.3)	0 (0.0)	6 (1.9)	0 (0.3)	91 (2.4)	2 (1.3)
Israel	x x	x x	x x	x x	x x	x x	x x
Japan	1 (0.8)	9 (2.6)	0 (0.0)	25 (3.8)	0 (0.0)	57 (4.4)	7 (2.3)
Korea	0 (0.0)	1 (0.7)	2 (1.6)	13 (2.8)	6 (1.7)	42 (3.9)	36 (3.8)
Kuwait	r 1 (0.7)	5 (2.2)	0 (0.0)	46 (4.3)	3 (1.9)	43 (4.3)	3 (1.7)
Latvia (LSS)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)	0 (0.0)	96 (2.1)	3 (1.6)
Netherlands	50 (4.8)	36 (4.8)	0 (0.0)	12 (3.3)	3 (1.8)	0 (0.0)	0 (0.0)
New Zealand	4 (1.2)	32 (4.4)	0 (0.0)	43 (4.5)	3 (1.5)	18 (3.4)	0 (0.0)
Norway	0 (0.0)	0 (0.0)	0 (0.0)	21 (4.2)	2 (1.4)	71 (4.8)	5 (2.2)
Portugal	0 (0.0)	1 (0.7)	0 (0.0)	12 (3.1)	0 (0.0)	70 (3.5)	17 (3.7)
Scotland	11 (2.9)	29 (4.6)	0 (0.4)	44 (4.7)	0 (0.0)	15 (3.6)	0 (0.0)
Singapore	0 (0.0)	1 (0.8)	1 (0.9)	5 (1.6)	7 (2.0)	39 (4.0)	47 (4.1)
Slovenia	0 (0.0)	0 (0.0)	0 (0.0)	4 (2.3)	0 (0.0)	88 (3.2)	7 (2.1)
Thailand	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.1)	6 (2.2)	20 (4.4)	72 (4.8)
United States	r 3 (1.7)	3 (1.8)	0 (0.0)	20 (3.7)	2 (0.8)	66 (4.2)	5 (1.1)

Percent of Students Taught by Teachers

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students.

An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.20

Teachers' Reports on Their Use of Students' Written Mathematics Homework[1] Upper Grade (Fourth Grade*)

Country	Percent of Students Taught by Teachers							
	Collecting, Correcting, and Then Returning Assignments to Students				Using Homework to Contribute Towards Students' Grades or Marks			
	Never	Rarely	Sometimes	Always	Never	Rarely	Sometimes	Always
Australia	r 1 (0.6)	9 (2.8)	32 (3.8)	58 (4.5)	r 30 (4.3)	29 (4.9)	33 (4.4)	8 (2.4)
Austria	2 (1.2)	6 (2.4)	33 (4.7)	59 (4.8)	36 (5.0)	52 (5.4)	10 (2.9)	1 (0.8)
Canada	3 (1.7)	7 (2.3)	45 (4.1)	44 (4.3)	23 (3.0)	16 (3.0)	45 (4.3)	16 (2.9)
Cyprus	s 1 (1.0)	9 (3.5)	49 (6.6)	40 (5.9)	s 28 (5.6)	21 (5.7)	37 (5.7)	14 (4.4)
Czech Republic	3 (1.4)	3 (1.2)	30 (3.8)	65 (4.1)	55 (4.4)	26 (3.7)	14 (3.0)	5 (1.9)
England	- -	- -	- -	- -	- -	- -	- -	- -
Greece	r 5 (2.0)	6 (2.4)	16 (3.0)	73 (3.6)	26 (3.3)	26 (3.6)	31 (3.6)	16 (3.0)
Hong Kong	1 (0.7)	1 (0.7)	7 (2.9)	91 (3.0)	61 (5.3)	25 (5.0)	11 (4.3)	2 (1.2)
Hungary	r 5 (2.1)	17 (3.7)	52 (5.1)	26 (4.4)	r 19 (3.5)	36 (4.8)	28 (4.2)	17 (3.2)
Iceland	1 (1.2)	5 (3.0)	24 (4.9)	70 (5.8)	46 (5.1)	13 (4.1)	32 (4.3)	9 (2.0)
Iran, Islamic Rep.	3 (2.0)	5 (2.2)	24 (4.3)	68 (4.3)	13 (3.1)	20 (3.9)	51 (4.9)	16 (3.5)
Ireland	3 (1.4)	4 (1.5)	29 (4.3)	65 (4.8)	39 (4.2)	24 (4.0)	30 (4.5)	7 (2.3)
Israel	x x	x x	x x	x x	x x	x x	x x	x x
Japan	12 (2.6)	17 (3.1)	20 (3.6)	51 (4.4)	71 (4.1)	19 (3.1)	8 (2.6)	2 (1.4)
Korea	1 (1.0)	6 (1.9)	54 (4.3)	39 (4.1)	7 (2.1)	24 (3.3)	59 (3.8)	10 (2.6)
Kuwait	r 0 (0.0)	4 (1.8)	20 (4.6)	76 (4.9)	r 2 (1.1)	14 (3.7)	51 (4.9)	33 (4.5)
Latvia (LSS)	2 (1.4)	4 (1.8)	17 (3.6)	77 (4.2)	30 (3.6)	24 (3.8)	26 (4.1)	20 (3.8)
Netherlands	r 10 (3.6)	1 (0.8)	22 (5.6)	67 (6.6)	r 35 (6.1)	13 (3.9)	43 (6.1)	9 (3.8)
New Zealand	13 (3.0)	11 (2.8)	33 (4.2)	43 (4.6)	49 (4.5)	27 (4.3)	22 (4.1)	2 (1.4)
Norway	2 (1.3)	2 (1.3)	32 (4.5)	64 (4.5)	9 (3.0)	19 (4.1)	61 (5.3)	10 (3.0)
Portugal	3 (1.6)	6 (2.2)	31 (4.4)	59 (4.9)	41 (4.8)	31 (4.7)	22 (3.5)	6 (1.8)
Scotland	- -	- -	- -	- -	- -	- -	- -	- -
Singapore	0 (0.0)	0 (0.0)	12 (2.3)	88 (2.3)	50 (3.9)	24 (3.4)	23 (3.4)	3 (1.2)
Slovenia	1 (1.0)	6 (2.4)	53 (5.2)	40 (4.6)	44 (4.6)	34 (4.5)	20 (4.2)	1 (1.3)
Thailand	r 1 (0.6)	0 (0.0)	5 (2.2)	94 (2.2)	r 22 (4.8)	9 (4.1)	48 (6.8)	21 (4.5)
United States	r 3 (0.9)	7 (1.7)	42 (3.7)	48 (4.1)	r 10 (2.3)	13 (1.8)	52 (3.7)	24 (2.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Based on those teachers who assign homework.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Appendix A

OVERVIEW OF TIMSS PROCEDURES: MATHEMATICS ACHIEVEMENT RESULTS FOR THIRD- AND FOURTH-GRADE STUDENTS

HISTORY

TIMSS represents the continuation of a long series of studies conducted by the International Association for the Evaluation of Educational Achievement (IEA). Since its inception in 1959, the IEA has conducted more than 15 studies of cross-national achievement in curricular areas such as mathematics, science, language, civics, and reading. IEA conducted its First International Mathematics Study (FIMS) in 1964, and the Second International Mathematics Study (SIMS) in 1980-82. The First and Second International Science Studies (FISS and SISS) were conducted in 1970-71 and 1983-84, respectively. Since the subjects of mathematics and science are related in many respects, the third studies were conducted together as an integrated effort.[1]

The number of participating countries, the number of grades tested, and testing both mathematics and science resulted in TIMSS becoming the largest, most complex IEA study to date and the largest international study of educational achievement ever undertaken. Traditionally, IEA studies have systematically worked toward gaining more in-depth understanding of how various factors contribute to the overall outcomes of schooling. Particular emphasis has been given to refining our understanding of students' opportunity to learn as this opportunity becomes successively defined and implemented by curricular and instructional practices. In an effort to extend what had been learned from previous studies and provide contextual and explanatory information, the magnitude of TIMSS expanded beyond the already substantial task of measuring achievement in two subject areas to also include a thorough investigation of curriculum and how it is delivered in classrooms around the world.

---

[1] Because a substantial amount of time has elapsed since earlier IEA studies in mathematics and science curriculum and testing methods in these two subjects have undergone many changes. Because TIMSS has devoted considerable energy towards reflecting the most current educational and measurement practices changes in items and methods as well as differences in the populations tested make comparisons of TIMSS results with those of previous studies very difficult. For example, SIMS did not include students at the lower grade levels. The focus of TIMSS is not on measuring achievement trends, but rather on providing up-to-date information about the current quality of education in mathematics and science.

THE COMPONENTS OF TIMSS

Continuing the approach of previous IEA studies, TIMSS addressed three conceptual levels of curriculum. The **intended curriculum** is composed of the mathematics and science instructional and learning goals as defined at the system level. The **implemented curriculum** is the mathematics and science curriculum as interpreted by teachers and made available to students. The **attained curriculum** is the mathematics and science content that students have learned and their attitudes towards these subjects. To aid in meaningful interpretation and comparison of results, TIMSS also collected extensive information about the social and cultural contexts for learning, many of which are related to variations among different educational systems.

Nearly 50 countries participated in one or more of the various components of the TIMSS data collection effort, including the curriculum analysis. To gather information about the intended curriculum, mathematics and science specialists within each participating country worked section by section through curriculum guides, textbooks, and other curricular materials to categorize aspects of these materials in accordance with detailed specifications derived from the TIMSS mathematics and science curriculum frameworks.[2] Initial results from this component of TIMSS can be found in two companion volumes: *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intention in School Mathematics* and *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*.[3]

To measure the attained curriculum, TIMSS tested more than half a million students in mathematics and science at five grade levels. TIMSS included testing at three separate populations:

Population 1. Students enrolled in the two adjacent grades that contained the largest proportion of 9-year-old students at the time of testing – third- and fourth-grade students in most countries.

Population 2. Students enrolled in the two adjacent grades that contained the largest proportion of 13-year-old students at the time of testing – seventh- and eighth-grade students in most countries.

Population 3. Students in their final year of secondary education. As an additional option, countries could test two special subgroups of these students:

1) Students taking advanced courses in mathematics, and
2) Students taking courses in physics.

---

[2] Robitaille, D.F., McKnight, C., Schmidt, W., Britton, E., Raizen, S., and Nicol, C. (1993). *TIMSS Monograph No. 1: Curriculum Frameworks for Mathematics and Science*. Vancouver, B.C.: Pacific Educational Press.

[3] Schmidt, W.H., McKnight, C.C., Valverde, G.A., Houang, R.T., and Wiley, D.E. (1997). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*. Dordrecht, the Netherlands: Kluwer Academic Publishers. Schmidt, W.H., Raizen, S.A., Britton, E.D., Bianchi, L.J., and Wolfe, R.G. (in press). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*. Dordrecht, the Netherlands: Kluwer Academic Publishers.

Countries participating in the study were required to administer tests to the students in the two grades at Population 2, but could choose whether or not to participate at the other levels. In about half of the countries at Populations 1 and 2, subsets of the upper-grade students who completed the written tests also participated in a performance assessment. In the performance assessment, students engaged in a number of hands-on mathematics and science activities. The students designed experiments, tested hypotheses, and recorded their findings. For example, in one task, students were asked to investigate probability by repeatedly rolling a die, applying a computational algorithm, and proposing explanations in terms of probability for patterns that emerged. Figure A.1 shows the countries that participated in the various components of TIMSS achievement testing.

TIMSS also administered a broad array of questionnaires to collect data about how the curriculum is implemented in classrooms, including the instructional practices used to deliver it. The questionnaires also were used to collect information about the social and cultural contexts for learning. Questionnaires were administered at the country level about decision-making and organizational features within their educational systems. The students who were tested answered questions pertaining to their attitudes towards mathematics and science, classroom activities, home background, and out-of-school activities. The mathematics and science teachers of sampled students responded to questions about teaching emphasis on the topics in the curriculum frameworks, instructional practices, textbook use, professional training and education, and their views on mathematics and science. The heads of schools responded to questions about school staffing and resources, mathematics and science course offerings, and teacher support. In addition, a volume was compiled that presents descriptions of the educational systems of the participating countries.[4]

With its enormous array of data, TIMSS has numerous possibilities for policy-related research, focused studies related to students' understandings of mathematics and science subtopics and processes, and integrated analyses linking the various components of TIMSS. The initial round of reports is only the beginning of a number of research efforts and publications aimed at increasing our understanding of how mathematics and science education functions across countries, investigating what impacts student performance, and helping to improve mathematics and science education.

---

[4] Robitaille, D.F. (Ed.). (1997). *National Contexts for Mathematics and Science Education: An Encyclopedia of the Education Systems Participating in TIMSS.* Vancouver, B.C.: Pacific Educational Press.

Figure A.1

Countries Participating in Components of TIMSS Testing

	Population 1		Population 2		Population 3		
Country	Written Test	Performance Assessment	Written Test	Performance Assessment	Mathematics & Science Literacy	Advanced Mathematics	Physics
Argentina			●				
Australia	●	●	●	●	●	●	●
Austria	●		●		●	●	●
Belgium (Fl)			●				
Belgium (Fr)			●				
Bulgaria			●				
Canada	●	●	●	●	●	●	●
Colombia			●	●			
Cyprus	●	●	●	●	●	●	●
Czech Republic	●	●	●	●	●	●	●
Denmark			●	●	●	●	●
England	●		●	●			
France			●		●	●	●
Germany			●		●	●	●
Greece	●		●			●	
Hong Kong	●	●	●	●			
Hungary	●		●		●		
Iceland	●		●		●		
Indonesia	●		●				
Iran, Islamic Rep.	●	●	●	●			
Ireland	●		●				
Israel	●	●	●	●	●	●	●
Italy	●		●		●		
Japan	●		●				
Korea	●		●				
Kuwait	●		●				
Latvia	●		●				●
Lithuania			●		●	●	
Mexico	●		●		●	●	●
Netherlands	●		●	●	●		
New Zealand	●	●	●	●	●		
Norway	●		●	●	●		●
Philippines			●				
Portugal	●	●	●	●			
Romania			●	●			
Russian Federation			●		●	●	●
Scotland	●		●	●			
Singapore	●		●	●			
Slovak Republic			●				
Slovenia	●	●	●	●	●	●	●
South Africa			●		●		
Spain			●	●			
Sweden			●	●	●	●	●
Switzerland			●	●	●	●	●
Thailand	●		●				
United States	●	●	●	●	●	●	●

DEVELOPING THE TIMSS MATHEMATICS TEST

The TIMSS curriculum framework underlying the mathematics tests at all three populations was developed by groups of mathematics educators with input from the TIMSS National Research Coordinators (NRCs). As shown in Figure A.2, the mathematics curriculum framework contains three dimensions or aspects. The content aspect represents the subject matter content of school mathematics. The performance expectations aspect describes, in a non-hierarchical way, the many kinds of performances or behaviors that might be expected of students in school mathematics. The perspectives aspect focuses on the development of students' attitudes, interest, and motivations in mathematics.[5]

Working within the mathematics curriculum framework, mathematics test specifications were developed for each population that included items representing a wide range of mathematics topics and eliciting a range of skills from the students. The tests were developed through an international consensus involving input from experts in mathematics and measurement specialists. The TIMSS Subject Matter Advisory Committee, including distinguished scholars from 10 countries, ensured that the test reflected current thinking and priorities within the field of mathematics. The items underwent an iterative development and review process, with multiple pilot testing efforts. Every effort was made to help ensure that the tests represented the curricula of the participating countries and that the items did not exhibit any bias towards or against particular countries, including modifying specifications in accordance with data from the curriculum analysis component, obtaining ratings of the items by subject matter specialists within the participating countries, and conducting thorough statistical item analysis of data collected in the pilot testing. The final forms of the test were endorsed by the NRCs of the participating countries.[6] In addition, countries had an opportunity to match the content of the test to their curricula at the third and fourth grades. They identified items measuring topics not covered in their intended curriculum. The information from this Test-Curriculum Matching Analysis indicates that omitting such items has little effect on the overall pattern of results (see Appendix B).

Table A.1 presents the six content areas included in the Population 1 mathematics test and the numbers of items and score points in each category. Distributions also are included for the four performance categories derived from the performance expectations aspect of the curriculum framework. Approximately one-fourth of the items were in the free-response format, requiring students to generate and write their own answers. Designed to represent approximately one-third of students' response time, some free-response questions asked for short answers while others required extended responses where students needed to show their work. The remaining questions used a multiple-choice format. In scoring the tests, correct answers to most questions were worth one point. Consistent with the approach of allotting students longer response time for the constructed-response questions than for multiple-choice questions, however, responses to some of these questions (particularly those requiring extended responses) were evaluated for partial credit, with a fully correct answer being awarded two points (see later section on scoring). This, in addition to the fact that several items had two parts, means that the total number of score points available for analysis somewhat exceeds the number of items included in the test.

---

[5] The complete TIMSS curriculum frameworks can be found in Robitaille, D.F. et al. (1993). *TIMSS Monograph No. 1: Curriculum Frameworks for Mathematics and Science.* Vancouver, B.C.: Pacific Educational Press.

[6] For a full discussion of the TIMSS test development effort, please see: Garden, R.A. and Orpwood, G. (1996) "TIMSS Test Development" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I.* Chestnut Hill, MA: Boston College; and Garden, R.A (1996). *No.2: Research Questions and Study Design.* Vancouver, B.C.: Pacific Educational Press.

The TIMSS instruments were prepared in English and translated into the additional languages used for testing. In addition, it sometimes was necessary to adapt the international versions for cultural purposes, including the countries that tested in English. This process represented an enormous effort for the national centers, with many checks along the way. The translation effort included: 1) developing explicit guidelines for translation and cultural adaptation, 2) translation of the instruments by the national centers in accordance with the guidelines and using two or more independent translations, 3) consultation with subject-matter experts regarding cultural adaptations to ensure that the meaning and difficulty of items did not change, 4) verification of the quality of the translations by professional translators from an independent translation company, 5) corrections by the national centers in accordance with the suggestions made, 6) verification that corrections were implemented, and 7) a series of statistical checks after the testing to detect items that did not perform comparably across countries.[7]

---

[7] More details about the translation verification procedures can be found in Mullis, I.V.S., Kelly, D.L., and Haley, K. (1996). "Translation Verification Procedures" in M.O. Martin and I.V.S. Mullis (Eds.), *Third International Mathematics and Science Study: Quality Assurance in Data Collection*. Chestnut Hill, MA: Boston College; and Maxwell, B. (1996). "Translation and Cultural Adaptation of the TIMSS Instruments" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College.

Figure A.2

The Three Aspects and Major Categories of the Mathematics Framework

Content

- Numbers
- Measurement
- Geometry
- Proportionality
- Functions, relations, and equations
- Data representation, probability, and statistics
- Elementary analysis
- Validation and structure

Performance Expectations

- Knowing
- Using routine procedures
- Investigating and problem solving
- Mathematical reasoning
- Communicating

Perspectives

- Attitudes
- Careers
- Participation
- Increasing interest
- Habits of mind

Table A.1

Distribution of Mathematics Items by Content Reporting Category and Performance Expectation - Population 1

Content Category	Percentage of Items	Number of Items	Number of Multiple-Choice Items	Number of Short-Answer Items	Number of Extended-Response Items	Number of Score Points¹
Whole Numbers	25%	25	19	5	1	27
Fractions and Proportionality	21%	21	15	2	4	26
Measurement, Estimation, and Number Sense	20%	20	16	3	1	21
Data Representation, Analysis, and Probability	12%	12	8	2	2	15
Geometry	14%	14	12	2	0	14
Patterns, Relations, and Functions	10%	10	9	1	0	10
Total	102%	102	79	15	8	113

Performance Expectation	Percentage of Items	Number of Items	Number of Multiple-Choice Items	Number of Short-Answer Items	Number of Extended-Response Items	Number of Score Points¹
Knowing	41%	42	35	7	0	38
Performing Routine Procedures	16%	16	13	3	0	16
Using Complex Procedures	24%	24	21	2	1	25
Solving Problems²	20%	20	10	3	7	34

[1] In scoring the tests correct answers to most items were worth one point. However, responses to some constructed-response items were evaluated for partial credit with a fully correct answer awarded up to two points. In addition, some items had two parts. Thus, the number of score points exceeds the number of items in the test.

[2] Includes one extended-response item classified as "Justifying and Proving" and three extended-response items and one short-answer item classified as "Communicating."

Because results are rounded to the nearest whole number some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

TIMSS TEST DESIGN

Not all of the students in Population 1 responded to all of the mathematics items. To ensure broad subject matter coverage without overburdening individual students, TIMSS used a rotated design that included both the mathematics and science items. Thus, the same students participated in both the mathematics and science testing. The TIMSS Population 1 test consisted of eight booklets, with each booklet requiring 64 minutes of student response time. The booklets were designed to be administered in two consecutive testing sessions with a 15- to 20-minute break in between. Students took four clusters of items (37 minutes) prior to the break and three clusters of items (27 minutes) after the break. In accordance with the design, the mathematics and science items were assembled into 26 different clusters (labeled A through Z). Cluster A was designed to take students 10 minutes to complete and the remaining clusters were designed to take 9 minutes each. In all, the design provided a total of 235 unique testing minutes, 118 for mathematics and 117 for science. Cluster A was a core cluster assigned to all booklets. The remaining clusters were assigned to the booklets in accordance with the rotated design so that representative samples of students responded to each cluster.[8]

SAMPLE IMPLEMENTATION AND PARTICIPATION RATES

The selection of valid and efficient samples is crucial to the quality and success of an international comparative study such as TIMSS. The accuracy of the survey results depends on the quality of the available sampling information and on the quality of the sampling activities themselves. For TIMSS, NRCs worked on all phases of sampling with staff from Statistics Canada. NRCs received training in how to select the school and student samples and in the use of the sampling software. In consultation with the TIMSS sampling referee (Keith Rust, Westat, Inc.), staff from Statistics Canada reviewed the national sampling plans, sampling data, sampling frames, and sample execution. This documentation was used by the International Study Center in consultation with Statistics Canada, the sampling referee, and the Technical Advisory Committee to evaluate the quality of the samples.

In a few situations where it was not possible to implement TIMSS testing for all of Population 1, as specified by the international desired definition (all students in the two adjacent grades with the greatest proportion of 9-year-olds), countries were permitted to define a national desired population that did not include part of the international desired population. Table A.2 shows any differences in coverage between the international and national desired populations. Most participants achieved 100% coverage (24 out of 26). The countries with less than 100% coverage are annotated in tables in this report. Israel and Latvia, as a matter of practicality, needed to define their tested populations according to the structure of their school systems. Because coverage fell below 65% for Latvia, the Latvian results have been labeled "Latvia (LSS)," for Latvian Speaking Schools, throughout the report.

---

[8] The design is fully documented in Adams, R. and Gonzalez, E. (1996). "Design of the TIMSS Achievement Instruments" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No. 2: Research Questions and Study Design*. Vancouver, B.C.: Pacific Education Press; and Adams, R. and Gonzalez, E. (1996). "TIMSS Test Design" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College.

Within the desired population, countries could define a population that excluded a small percentage (less than 10%) of certain kinds of schools or students that would be very difficult or resource intensive to test (e.g., schools for students with special needs or schools that were very small or located in extremely remote areas). Table A.2 also shows that the degree of such exclusions was small. Only England exceeded the 10% limit, and this is annotated in the tables in this report. This primarily was because schools which were taking part in trials for National Curriculum Assessment (5.8% of students) were excluded.

Countries were required to test the two adjacent grades with the greatest proportion of 9-year-olds. Table A.3 presents, for each country, the percentage of 9-year-olds in the lower grade tested, the percentage in the upper grade, and the percentage in the upper and lower grades combined.

Within countries, TIMSS used a two-stage sample design at Population 1, where the first stage involved selecting 150 public and private schools within each country. Within each school, the basic approach required countries to use random procedures to select one mathematics class at the fourth grade and one at the third grade (or the corresponding upper and lower grades in that country). All of the students in those two classes were to participate in the TIMSS testing. This approach was designed to yield a representative sample of 7,500 students per country, with approximately 3,750 students at each grade.[9] Typically, between 450 and 3,750 students responded to each item at each grade level, depending on the booklets in which the items were located.

Countries were required to obtain a participation rate of at least 85% of both schools and students, or a combined rate (the product of school and student participation) of 75%. Tables A.4 through A.8 present the participation rates and achieved sample sizes for the fourth and third grades.

---

[9] The sample design for TIMSS is described in detail in Foy, P., Rust, K. and Schleicher, A., (1996). "TIMSS Sample Design" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College.

Table A.2

Coverage of TIMSS Target Population

The International Desired Population is defined as follows:
Population 1 - All students enrolled in the two adjacent grades with the largest proportion of 9-year-old students at the time of testing.

Country	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Australia	100%		0.1%	1.6%	1.8%
Austria	100%		2.6%	0.2%	2.8%
Canada	100%		2.5%	3.6%	6.2%
Cyprus	100%		3.1%	0.1%	3.2%
Czech Republic	100%		4.1%	0.0%	4.1%
[2] England	100%		8.6%	3.5%	12.1%
Greece	100%		1.5%	4.0%	5.4%
Hong Kong	100%		2.6%	0.0%	2.7%
Hungary	100%		3.8%	0.0%	3.8%
Iceland	100%		1.9%	4.3%	6.2%
Iran, Islamic Rep.	100%		0.3%	1.0%	1.3%
Ireland	100%		5.3%	1.6%	6.9%
[1] Israel	72%	Hebrew Public Education System	1.1%	0.1%	1.2%
Japan	100%		3.0%	0.0%	3.0%
Korea	100%		3.9%	2.6%	6.6%
Kuwait	100%		0.0%	0.0%	0.0%
[1] Latvia (LSS)	60%	Latvian-speaking schools	2.1%	0.0%	2.1%
Netherlands	100%		4.0%	0.4%	4.4%
New Zealand	100%		0.7%	0.6%	1.3%
Norway	100%		1.1%	2.0%	3.1%
Portugal	100%		6.6%	0.7%	7.3%
Scotland	100%		2.4%	4.3%	6.7%
Singapore	100%		0.0%	0.0%	0.0%
Slovenia	100%		1.9%	0.0%	1.9%
Thailand	100%		6.8%	1.5%	8.3%
United States	100%		0.4%	4.3%	4.7%

[1] National Desired Population does not cover all of International Desired Population. Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.3

Coverage of 9-Year-Old Students

Country	Percent of 9-Year-Olds in Lower Grade (Third Grade*)	Percent of 9-Year-Olds in Upper Grade (Fourth Grade*)	Percent of 9-Year-Olds in Both Grades
Australia	65	29	94
Austria	72	15	87
Canada	46	48	94
Cyprus	35	63	98
Czech Republic	75	15	91
England	58	41	99
Greece	11	88	99
Hong Kong	43	50	93
Hungary	70	19	89
Iceland	15	84	99
Iran, Islamic Rep.	51	32	83
Ireland	68	23	92
Israel	-	-	-
Japan	91	9	99
Korea	67	24	91
Kuwait	-	-	-
Latvia (LSS)	55	21	76
Netherlands	63	30	93
New Zealand	50	49	99
Norway	38	62	100
Portugal	45	48	93
Scotland	23	76	99
Singapore	80	17	98
Slovenia	60	0	60
Thailand	60	11	71
United States	61	34	95

*Third and fourth grades in most countries; see Table 2 for more information about the grades tested in each country.
A dash (–) indicates data are unavailable. Israel and Kuwait did not test the lower grade.
Because results are rounded to the nearest whole number some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.4

School Participation Rates and Sample Sizes

Upper Grade (Fourth Grade*)

Country	School Participation Before Replacement (Weighted Percentage)	School Participation After Replacement (Weighted Percentage)	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample That Participated	Number of Replacement Schools That Participated		Total Number of Schools That Participated
						Procedural	Other	
Australia	66	69	268	268	169	9	0	178
Austria	51	72	150	150	71	31	31	133
Canada	90	90	423	420	390	0	0	390
Cyprus	97	97	150	150	146	0	0	146
Czech Republic	91	94	215	215	181	7	0	188
England	63	88	150	145	92	35	0	127
Greece	93	93	187	187	174	0	0	174
Hong Kong	84	84	156	148	124	0	0	124
Hungary	100	100	150	150	150	0	0	150
Iceland	95	95	153	151	144	0	0	144
Iran, Islamic Rep.	100	100	180	180	180	0	0	180
Ireland	94	96	175	173	161	4	0	165
Israel	40	40	100	100	40	0	47	87
Japan	93	96	150	150	137	4	0	141
Korea	100	100	150	150	150	0	0	150
Kuwait	100	100	150	150	150	0	0	150
Latvia (LSS)	74	74	169	169	125	0	0	125
Netherlands	31	62	196	196	63	67	0	130
New Zealand	80	99	150	150	120	29	0	149
Norway	85	94	150	148	126	13	0	139
Portugal	95	95	150	150	143	0	0	143
Scotland	78	83	184	184	143	9	0	152
Singapore	100	100	191	191	191	0	0	191
Slovenia	81	81	150	150	121	0	0	121
Thailand	96	96	155	155	154	0	0	154
United States	85	85	220	213	182	0	0	182

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Replacement schools selected in accordance with the TIMSS sampling procedures are listed in the "procedural" column. Those selected using unapproved methods are listed in the "other" column and were not included in the computation of school participation rates.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.5

Student Participation Rates and Sample Sizes

Upper Grade (Fourth Grade*)

Country	Within School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class School	Number of Students Excluded	Number of Students Eligible	Number of Students Absent	Total Number of Students Assessed
Australia	96	6930	37	104	6789	282	6507
Austria	96	2779	12	6	2761	116	2645
Canada	96	9193	81	268	8844	436	8408
Cyprus	86	3972	4	3	3965	589	3376
Czech Republic	92	3555	7	0	3548	280	3268
England	95	3489	73	122	3294	168	3126
Greece	95	3358	6	116	3236	183	3053
Hong Kong	98	4475	0	1	4474	63	4411
Hungary	92	3272	0	0	3272	266	3006
Iceland	90	2149	23	101	2025	216	1809
Iran, Islamic Rep.	97	3521	5	36	3480	95	3385
Ireland	93	3134	14	40	3080	207	2873
Israel	94	2486	0	3	2483	132	2351
Japan	97	4453	0	0	4453	147	4306
Korea	95	2971	133	0	2838	26	2812
Kuwait	95	4578	34	0	4544	226	4318
Latvia (LSS)	93	2390	12	1	2377	161	2216
Netherlands	96	2639	0	4	2635	111	2524
New Zealand	96	2627	82	20	2525	104	2421
Norway	97	2391	16	42	2333	76	2257
Portugal	96	2994	15	16	2963	110	2853
Scotland	92	3735	0	139	3596	295	3301
Singapore	98	7274	14	0	7260	121	7139
Slovenia	94	2720	3	0	2717	151	2566
Thailand	100	3042	0	50	2992	0	2992
United States	94	8224	61	412	7751	455	7296

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.6

School Participation Rates and Sample Sizes
Lower Grade (Third Grade*)

Country	School Participation Before Replacement (Weighted Percentage)	School Participation After Replacement (Weighted Percentage)	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample That Participated	Number of Replacement Schools That Participated		Total Number of Schools That Participated
						Procedural	Other	
Australia	66	69	268	264	166	9	0	175
Austria	49	70	150	149	68	29	31	128
Canada	88	88	423	418	375	0	0	375
Cyprus	98	98	150	150	147	0	0	147
Czech Republic	91	93	215	215	180	7	0	187
England	64	88	150	145	93	35	0	128
Greece	91	91	187	187	171	0	0	171
Hong Kong	84	84	156	147	123	0	0	123
Hungary	99	99	150	150	149	0	0	149
Iceland	95	95	153	152	144	0	0	144
Iran, Islamic Rep.	99	99	180	180	178	0	0	178
Ireland	94	96	175	173	160	4	0	164
Israel	-	-	-	-	-	-	-	-
Japan	93	95	150	150	137	5	0	142
Korea	100	100	150	150	150	0	0	150
Kuwait	-	-	-	-	-	-	-	-
Latvia (LSS)	73	73	169	168	123	0	0	123
Netherlands	29	62	196	195	60	69	0	129
New Zealand	80	99	150	150	120	29	0	149
Norway	83	92	150	148	124	12	0	136
Portugal	95	95	150	150	143	0	0	143
Scotland	77	81	184	184	142	8	0	150
Singapore	100	100	191	191	191	0	0	191
Slovenia	81	81	150	149	122	0	0	122
Thailand	96	96	155	154	153	0	0	153
United States	86	86	220	217	186	0	0	186

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.

A dash (–) indicates data are unavailable. Israel and Kuwait did not test the lower grade.

[†] Replacement schools selected in accordance with the TIMSS sampling procedures are listed in the "procedural" column. Those selected using unapproved methods are listed in the "other" column and were not included in the computation of school participation rates.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.7

Student Participation Rates and Sample Sizes
Lower Grade (Third Grade*)

Country	Within School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn From Class School	Number of Students Excluded	Number of Students Eligible	Number of Students Absent	Total Number of Students Assessed
Australia	95	5138	31	92	5015	274	4741
Austria	96	2655	10	6	2639	113	2526
Canada	96	8433	77	307	8049	455	7594
Cyprus	85	3913	5	2	3906	598	3308
Czech Republic	93	3484	8	0	3476	220	3256
England	94	3468	70	158	3240	184	3056
Greece	94	3263	4	133	3126	171	2955
Hong Kong	99	4455	0	2	4453	57	4396
Hungary	94	3270	0	0	3270	232	3038
Iceland	91	2017	19	89	1909	211	1698
Iran, Islamic Rep.	98	3504	12	49	3443	82	3361
Ireland	94	3127	14	39	3074	185	2889
Israel	-	-	-	-	-	-	-
Japan	97	4433	0	0	4433	127	4306
Korea	94	2969	138	2	2829	52	2777
Kuwait	-	-	-	-	-	-	-
Latvia (LSS)	94	2218	8	0	2210	156	2054
Netherlands	96	2923	0	14	2909	119	2790
New Zealand	95	2733	91	9	2633	129	2504
Norway	97	2362	8	59	2295	76	2219
Portugal	97	2790	13	31	2746	96	2650
Scotland	90	3663	0	187	3476	344	3132
Singapore	98	7223	14	0	7209	179	7030
Slovenia	95	2659	5	0	2654	133	2521
Thailand	100	2945	0	74	2871	1	2870
United States	95	4280	40	201	4039	220	3819

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
A dash (–) indicates data are unavailable. Israel and Kuwait did not test the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.8

Overall Participation Rates
Lower and Upper Grades (Third and Fourth Grades*)

Country	Upper Grade		Lower Grade	
	Overall Participation Before Replacement (Weighted Percentage)	Overall Participation After Replacement (Weighted Percentage)	Overall Participation Before Replacement (Weighted Percentage)	Overall Participation After Replacement (Weighted Percentage)
Australia	63	66	62	65
Austria	49	69	46	67
Canada	86	86	84	84
Cyprus	83	83	83	83
Czech Republic	84	86	85	87
England	60	83	61	83
Greece	88	88	86	86
Hong Kong	83	83	83	83
Hungary	92	92	93	93
Iceland	86	86	86	86
Iran, Islamic Rep.	97	97	97	97
Ireland	88	90	88	91
Israel	38	38	-	-
Japan	90	92	90	93
Korea	95	95	94	94
Kuwait	95	95	-	-
Latvia (LSS)	69	69	69	69
Netherlands	29	59	28	60
New Zealand	77	95	76	95
Norway	82	91	81	89
Portugal	92	92	92	92
Scotland	71	76	69	73
Singapore	98	98	98	98
Slovenia	76	76	77	77
Thailand	96	96	96	96
United States	80	80	81	81

*Third and Fourth grades in most countries; see Table 2 for information about the grades tested in each country.
A dash (-) indicates data are unavailable. Israel and Kuwait did not test the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

INDICATING COMPLIANCE WITH SAMPLING GUIDELINES IN THE REPORT

Figure A.3 shows how countries have been grouped in tables reporting achievement results. Countries that complied with the TIMSS guidelines for grade selection and classroom sampling, and that achieved acceptable participation rates, are shown in both the schools and students or a combined rate (the product of school and student participation) of 75% with or without replacement schools. Countries that met the guidelines only after including replacement schools are annotated. These countries (17 at the fourth grade and 16 at the third grade) appear in the tables in Chapters 1, 2, and 3 ordered by achievement.

Countries that did not reach at least 50% school participation without the use of replacements schools, or that failed to reach the sampling participation standard even with the inclusion of replacement schools, are shown in the second panel of Figure A.3. These countries are presented in a separate section of the achievement tables in Chapters 1, 2, and 3 in alphabetical order, and are shown in tables in Chapters 4 and 5 in italics.

To provide a better curricular match, Slovenia elected to test its third- and fourth-grade students even though that meant not testing the two grades with the most 9-year-olds and resulted in its students being somewhat older than those in the other countries. Slovenia is also presented in a separate section of the achievement tables in Chapters 1, 2, and 3 and is shown in tables in Chapters 4 and 5 in italics. Table A.3 shows the percentage of 9-year-olds for each country in the grades tested.

Hungary did not completely comply with the guidelines for sampling classrooms at the fourth grade and thus its results are also presented in a separate section of the achievement tables in Chapters 1, 2, and 3 in alphabetical order, and are italicized in tables in Chapters 4 and 5. At the fourth grade, Israel, Kuwait, and Thailand also had difficulty complying with the classroom selection guidelines, but in addition had other difficulties (Kuwait tested a single grade with relatively few 9-year-olds; Israel had low sampling participation rates; Thailand had a high percentage of older students), and so these countries are also presented in separate sections in tables in Chapters 1, 2, and 3, and are italicized in tables in Chapters 4 and 5. Israel and Kuwait did not test at the lower grade.

Figure A.3

Countries Grouped for Reporting of Achievement According to Their Compliance with Guidelines for Sample Implementation and Participation Rates

	Fourth Grade	Third Grade
Countries satisfying guidelines for sample participation rates, grade selection and sampling procedures	Canada Cyprus Czech Republic [†][2] England Greece Hong Kong Iceland Iran, Islamic Rep. Ireland Japan Korea New Zealand Norway Portugal [†] Scotland Singapore United States	Canada Cyprus Czech Republic [†][2] England Greece Hong Kong Iceland Iran, Islamic Rep. Ireland Japan Korea New Zealand Norway Portugal Singapore United States
Countries not satisfying guidelines for sample participation	Australia Austria [1] Latvia (LSS) Netherlands	Australia Austria [1] Latvia (LSS) Netherlands Scotland
Countries not meeting age/grade specifications (high percentage of older students)	Slovenia	Slovenia
Countries with unapproved sampling procedures at the classroom level	Hungary	Hungary
Countries with unapproved sampling procedures at classroom level and not meeting other guidelines	[1] Israel Kuwait Thailand	Thailand

---

[†] Met guidelines for sample participation rates only after replacement schools were included.

[1] National Desired Population does not cover all of International Desired Population (see Table 1). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table 1).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

DATA COLLECTION

Each participating country was responsible for carrying out all aspects of the data collection, using standardized procedures developed for the study. Training manuals were developed for school coordinators and test administrators that explained procedures for receipt and distribution of materials as well as for the activities related to the testing sessions. The test administrator manuals covered procedures for test security, standardized scripts to regulate directions and timing, rules for answering students' questions, and steps to ensure that identification on the test booklets and questionnaires corresponded to the information on the forms used to track students.

Each country was responsible for conducting quality control procedures and describing this effort as part of the NRC's report documenting procedures used in the study. In addition, the International Study Center considered it essential to establish some method to monitor compliance with standardized procedures. NRCs were each asked to nominate a person, such as a retired school teacher, to serve as the quality control monitor for his or her own country, and in almost all cases, the International Study Center adopted the NRC's first suggestion. The International Study Center developed manuals for the quality control monitors and briefed them in two-day training sessions about TIMSS, the responsibilities of the national centers in conducting the study, and their own roles and responsibilities.

The quality control monitors interviewed the NRCs about data collection plans and procedures. They also selected a sample of approximately 10 schools to visit, where they observed testing sessions and interviewed school coordinators.[10] Quality control monitors observed test administrations and interviewed school coordinators in 37 countries, and interviewed school coordinators or test administrators in 3 additional countries.

The results of the interviews indicate that, in general, NRCs had prepared well for data collection and, despite the heavy demands of the schedule and shortages of resources, were in a position to conduct the data collection in an efficient and professional manner. Similarly, the TIMSS tests appeared to have been administered in compliance with international procedures, including the activities preliminary to the testing session, the activities during the testing sessions, and the school-level activities related to receiving, distributing, and returning materials from the national centers.

---

[10] The results of the interviews and observations by the quality control monitors are presented in Martin, M.O., Hoyle, C.D., and Gregory, K.D. (1996). "Monitoring the TIMSS Data Collection" and "Observing the TIMSS Test Administration," both in M.O. Martin and I.V.S. Mullis (Eds.), *Third International Mathematics and Science Study: Quality Assurance in Data Collection.* Chestnut Hill, MA: Boston College.

SCORING THE FREE-RESPONSE ITEMS

Because approximately one-third of the written test time was devoted to free-response items, TIMSS needed to develop procedures for reliably evaluating student responses within and across countries. Scoring utilized two-digit codes with rubrics specific to each item. Development of the rubrics was led by the Norwegian TIMSS national center. The first digit designates the correctness level of the response. The second digit, combined with the first digit, represents a diagnostic code used to identify specific types of approaches, strategies, or common errors and misconceptions. Although not specifically used in this report, analyses of responses based on the second digit should provide insight into ways to help students better understand mathematics concepts and problem-solving approaches.

To meet the goal of implementing reliable scoring procedures based on the TIMSS rubrics, the International Study Center prepared guides containing the rubrics and explanations of how to implement them, together with example student responses for the various rubric categories. These guides, together with more examples of student responses for practice in applying the rubrics, were used as a basis for an ambitious series of regional training sessions. The training sessions were designed to assist representatives of national centers who would then be responsible for training personnel in their respective countries to apply the two-digit codes reliably.[11]

To gather and document empirical information about the within-country agreement among scorers, TIMSS developed a procedure whereby systematic subsamples of approximately 10% of the students' responses were to be coded independently by two different readers. Table A.9 shows the average and range of the within-country percentage of exact agreement between scorers on the free-response items in the Population 1 mathematics test for 16 countries. Unfortunately, lack of resources precluded several countries from providing this information. A very high percentage of exact agreement was observed, with averages across the items for the correctness score ranging from 94% to 99% and an overall average of 97% across the 16 countries.

To provide information about the cross-country agreement among scorers, TIMSS conducted a special study at Population 2, where 39 scorers from 21 of the participating countries evaluated common sets of students' responses to more than half of the free-response items. Unfortunately, resources did not allow an international reliability study to be conducted for Population 1. However, the results of the international reliability study at Population 2 demonstrated a very high percentage of exact agreement on the correctness and diagnostic scores. The TIMSS data from the reliability studies indicate that scoring procedures were extremely robust for the mathematics items, especially for the correctness score used for the analyses in this report.[12]

---

[11] The procedures used in the training sessions are documented in Mullis, I.V.S., Garden, R.A., and Jones, C.A. (1996). "Training for Scoring the TIMSS Free-Response Items" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College.

[12] Details about the reliability studies can be found in Mullis, I.V.S., and Smith, T.A. (1996). "Quality Control Steps for Free-Response Scoring" in M.O. Martin and I.V.S. Mullis (Eds.), *Third International Mathematics and Science Study: Quality Assurance in Data Collection*. Chestnut Hill, MA: Boston College.

Table A.9

TIMSS Within-Country Free-Response Coding Reliability Data for Population 1 Mathematics Items*

Country	Correctness Score Agreement			Diagnostic Code Agreement		
	Average Percent of Exact Agreement Across Items	Range of Percent of Exact Agreement		Average Percent of Exact Agreement Across Items	Range of Percent of Exact Agreement	
		Min	Max		Min	Max
Australia	96	76	100	90	69	100
Canada	95	81	100	90	67	99
Czech Republic	98	93	100	95	85	100
England	99	93	100	97	87	100
Hong Kong	96	85	99	91	73	98
Ireland	98	89	100	94	85	99
Iran, Islamic Rep.	94	84	99	88	74	96
Israel	96	86	100	92	65	100
Japan	99	98	100	99	96	100
Netherlands	96	84	100	92	78	100
Norway	99	95	100	96	80	100
New Zealand	99	96	100	96	88	100
Portugal	97	89	99	95	82	98
Scotland	94	79	99	86	62	97
Singapore	98	90	100	96	89	100
United States	99	93	100	96	81	100
AVERAGE	97	88	100	93	79	99

*Based on 23 mathematics items, including 4 multiple-part items.

Note: Percent agreement was computed separately for each part, and each part was treated as a separate item in computing averages and ranges.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

TEST RELIABILITY

Table A.10 displays the mathematics test reliability coefficient for each country for the lower and upper grades (usually third and fourth grades). This coefficient is the median KR-20 reliability across the eight test booklets. Median reliabilities in the lower grade ranged from .72 to .87, and in the upper grade from .74 to .88. The international median, shown in the last row of the table, is the median of the reliability coefficients for all countries. These international medians are .82 for the lower grade and .84 for the upper grade.

DATA PROCESSING

To ensure the availability of comparable, high-quality data for analysis, TIMSS engaged in a rigorous set of quality control steps to create the international database.[13] TIMSS prepared manuals and software for countries to use in entering their data so that the information would be in a standardized international format before being forwarded to the IEA Data Processing Center in Hamburg for creation of the international database. Upon arrival at the IEA Data Processing Center, the data from each country underwent an exhaustive cleaning process. The data cleaning process involved several iterative steps and procedures designed to identify, document, and correct deviations from the international instruments, file structures, and coding schemes. This process also emphasized consistency of information within national data sets and appropriate linking among the many student, teacher, and school data files.

Throughout the process, the data were checked and double-checked by the IEA Data Processing Center, the International Study Center, and the national centers. The national centers were contacted regularly and given multiple opportunities to review the data for their countries. In conjunction with the Australian Council for Educational Research (ACER), the International Study Center conducted a review of item statistics for each of the cognitive items in each of the countries to identify poorly performing items. Six countries had one or more mathematics items deleted (in most cases, one). Usually the poor statistics (negative point-biserials for the key, large item-by-country interactions, and statistics indicating lack of fit with the model) were a result of translation, adaptation, or printing deviations.

---

[13] These steps are detailed in Jungclaus, H. and Bruneforth, M. (1996). "Data Consistency Checking Across Countries" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College.

Table A.10

Cronbach's Alpha Reliability Coefficients[1]
TIMSS Mathematics Test
Lower and Upper Grades (Third and Fourth Grades*)

Country	Lower Grade	Upper Grade
Australia	0.85	0.86
Austria	0.79	0.79
Canada	0.82	0.85
Cyprus	0.79	0.85
Czech Republic	0.83	0.84
England	0.84	0.86
Greece	0.84	0.86
Hong Kong	0.80	0.84
Hungary	0.84	0.84
Iceland	0.73	0.83
Iran, Islamic Rep.	0.72	0.79
Ireland	0.83	0.84
Israel	-	0.83
Japan	0.82	0.82
Korea	0.79	0.82
Kuwait	-	0.74
Latvia (LSS)	0.80	0.82
Netherlands	0.76	0.79
New Zealand	0.83	0.86
Norway	0.77	0.81
Portugal	0.83	0.82
Scotland	0.81	0.86
Singapore	0.87	0.88
Slovenia	0.82	0.82
Thailand	0.81	0.81
United States	0.83	0.86
International Median	0.82	0.84

---

*Third and fourth grades in most countries; see Table 2 for more information about the grades tested in each country.

[1] The reliability coefficient for each country is the median KR-20 reliability across the eight test booklets. The international median is the median of the reliability coefficients for all countries.

A dash (-) indicates data are unavailable. Israel and Kuwait did not test the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

IRT SCALING AND DATA ANALYSIS

Two general analysis approaches were used for this report – item response theory scaling methods and average percent correct technology. The overall mathematics results were summarized using an item response theory (IRT) scaling method (Rasch model). This scaling method produces a mathematics score by averaging the responses of each student to the items that student took in a way that takes into account the difficulty of each item. The methods used in TIMSS include refinements that enable reliable scores to be produced even though individual students responded to relatively small subsets of the total mathematics item pool. Analyses of the response patterns of students from participating countries indicated that, although the items in the test address a wide range of mathematical content, the performance of the students across the items was sufficiently consistent to be usefully summarized in a single mathematics score.

An IRT approach was preferred for developing comparable estimates of performance for all students, since students answered different test items depending upon which of the eight test booklets they received. The IRT analysis provides a common scale on which performance can be compared across countries. In addition to providing a basis for estimating mean achievement, scale scores permit estimates of how students within countries vary and provide information on percentiles of performance. The scale was standardized using students from both the grades tested. When all participating countries and grades are treated equally, the TIMSS scale average is 500 and the standard deviation is 100. Since the countries varied in size, each country was reweighted to contribute equally to the mean and standard deviation of the scale. The average of the scale scores was constructed to be the average of the 26 means of participants that were available at the fourth grade and the 24 means at the third grade. The average and standard deviation of the scale scores are arbitrary and do not affect scale interpretations.

The analytic approach underlying the results in Chapters 2 and 3 of this report involved calculating the percentage of correct answers for each item for each participating country (as well as the percentages of different types of incorrect responses). The percentages of correct responses were averaged to summarize mathematics performance overall and in each of the content areas for each country as a whole and by gender. For items with more than one part, each part was analyzed separately in calculating the percentage of correct responses. Also, for items with more than one point awarded for full credit, the percentage of correct responses reflects an average of the points received by students in each country. This was achieved by including the percentage of students receiving one score point as well as the percentage receiving two score points in the calculations. Thus, the average percent correct is based on the number of score points rather than the number of items, per se. An exception to this is the international average percent correct reported for example items, where the values reflect the percentage of students receiving full credit.

ESTIMATING THE LINK BETWEEN FOURTH- AND EIGHTH-GRADE PERFORMANCE

Fifteen of the items in mathematics (15%) and 18 in science (19%) were included in the tests at both Populations 1 and 2. The difference in performance between the populations on these items was used to estimate the link between the third and fourth grades on one hand and the seventh and eighth grades on the other.

For each of the link items, the international item difficulty level from the IRT analyses for Population 1 was subtracted from the international difficulty level at Population 2. Investigations of the results indicated that the increases between the two populations were relatively stable across items, especially in mathematics. It also was determined that between-grade increases between the third and fourth grades and between the seventh and eighth grades on the link items were consistent with the between-grade increases observed on the entire pool of items for Populations 1 and 2, respectively. Thus, the average difference across items was used to estimate the difference in performance between the two populations.

In making the link, results for the third- and fourth-grade students were placed on the scale used to report seventh- and eighth-grade performance. Because of the difference in variances between the scales for Populations 1 and 2, it first was necessary to transform the Population 1 scales. The adjustment factor for mathematics was .96 and for science was 1.25. Next, a constant (121 scale points for mathematics and 283 for science) was subtracted from the Population 1 results for each country.

The country means for the third and fourth grades transformed to the seventh- and eighth-grade scale are shown in Table A.11. The results shown in Table A.11 are based on all items administered to the third and fourth graders. The relative standings of the countries are identical to those presented in Chapter 1. Since there were relatively few items in common, the size of the link is approximate. The standard errors for the third- and fourth-grade estimates incorporate an added component to account for the uncertainty of this approximation. Because the link is very approximate, the achievement increases between the third/fourth grades and the seventh/eighth grades must be interpreted with extreme caution.

Table A.11

Mathematics Performance at the Third, Fourth, Seventh, and Eighth Grades* Based on the Population 2 (Seventh- and Eighth-Grade) Scale

Country	Third Grade Mean	Fourth Grade Mean	Seventh Grade Mean	Eighth Grade Mean
Australia	347 (8.8)	408 (8.4)	498 (3.8)	530 (4.0)
Austria	351 (9.4)	421 (8.4)	509 (3.0)	539 (3.0)
Canada	334 (8.3)	395 (8.5)	494 (2.2)	527 (2.4)
Cyprus	296 (8.3)	366 (8.4)	446 (1.9)	474 (1.9)
Czech Republic	361 (8.5)	428 (8.5)	523 (4.9)	564 (4.9)
England	321 (8.4)	376 (8.5)	476 (3.7)	506 (2.6)
Greece	294 (8.8)	356 (8.9)	440 (2.8)	484 (3.1)
Hong Kong	387 (8.4)	447 (8.9)	564 (7.8)	588 (6.5)
Hungary	340 (8.9)	410 (8.7)	502 (3.7)	537 (3.2)
Iceland	276 (8.3)	338 (8.3)	459 (2.6)	487 (4.5)
Iran, Islamic Rep.	245 (8.6)	294 (8.8)	401 (2.0)	428 (2.2)
Ireland	340 (8.6)	412 (8.6)	500 (4.1)	527 (5.1)
Israel	- -	394 (8.6)	- -	522 (6.2)
Japan	400 (8.0)	457 (8.1)	571 (1.9)	605 (1.9)
Korea	422 (8.2)	471 (8.1)	577 (2.5)	607 (2.4)
Kuwait	- -	267 (8.3)	- -	392 (2.5)
Latvia (LSS)	328 (8.9)	388 (9.2)	462 (2.8)	493 (3.1)
Netherlands	357 (8.3)	438 (8.5)	516 (4.1)	541 (6.7)
New Zealand	305 (8.8)	362 (8.9)	472 (3.8)	508 (4.5)
Norway	287 (8.4)	365 (8.4)	461 (2.8)	503 (2.2)
Portugal	291 (8.7)	340 (8.6)	423 (2.2)	454 (2.5)
Scotland	323 (8.5)	383 (8.7)	463 (3.7)	498 (5.5)
Singapore	414 (9.1)	484 (9.4)	601 (6.3)	643 (4.9)
Slovenia	351 (8.4)	414 (8.5)	498 (3.0)	541 (3.1)
Thailand	309 (9.3)	354 (9.1)	495 (4.9)	522 (5.7)
United States	344 (8.5)	407 (8.4)	476 (5.5)	500 (4.6)
International Averages	334 (1.8)	391 (1.7)	493 (0.8)	520 (0.8)

*Third, fourth, seventh, and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are unavailable. Israel and Kuwait did not test the third or seventh grades.
Note: Since there are only 15 mathematics items in common in the tests given to the two grades, the estimate of the relationship is approximate.
The standard errors for the third- and fourth-grade estimates incorporate an added component to account for the uncertainty of this approximation.
The seventh- and eighth-grade means are the same as those reported in *Mathematics Achievement in the Middle School Years: IEA's Third and Science Study.*

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

ESTIMATING SAMPLING ERROR

Because the statistics presented in this report are estimates of national performance based on samples of students, rather than the values that could be calculated if every student in every country had answered every question, it is important to have measures of the degree of uncertainty of the estimates. The jackknife procedure was used to estimate the standard error associated with each statistic presented in this report. The use of confidence intervals, based on the standard errors, provides a way to make inferences about the population means and proportions in a manner that reflects the uncertainty associated with the sample estimates. An estimated sample statistic plus or minus two standard errors represents a 95% confidence interval for the corresponding population result.

Appendix B

THE TEST-CURRICULUM MATCHING ANALYSIS

When comparing student achievement across countries, it is important that the comparisons be as "fair" as possible. TIMSS has worked towards this goal in a number of ways, including providing detailed procedures for standardizing the population definitions, sampling, test translations, test administration, scoring, and database formation. Developing the TIMSS tests involved the interaction of experts in the field of mathematics with representatives of the participating countries and testing specialists.[1] The National Research Coordinators (NRCs) from each country formally approved the TIMSS test, thus accepting it as being sufficiently fair to compare their students' mathematics achievement with that of students from other countries.

Although the TIMSS test was developed to represent a set of agreed-upon mathematics content areas, there are differences among the curricula of participating countries that result in various mathematics topics being taught at different grades. To restrict test items not only to those topics in the curricula of all countries but also to those covered in the same sequence in all participating countries would severely limit test coverage and restrict the research questions about international differences that TIMSS is designed to address. The TIMSS tests, therefore, inevitably contain some items measuring topics unfamiliar to some students in some countries.

The Test-Curriculum Matching Analysis (TCMA) was developed and conducted to investigate the appropriateness of the TIMSS mathematics test for third- and fourth-grade students in the participating countries, and to show how student performance for individual countries varied when based only on the test questions that were judged to be relevant to their own curriculum.[2]

To gather data about the extent to which the TIMSS tests were relevant to the curriculum of the participating countries, TIMSS asked the NRC of each country to report whether or not each item was in the country's intended curriculum at each of the two grades being tested. The NRC was asked to choose a person or persons who were very familiar with the curricula at the grades being tested to make the determination. Since an item might be in the curriculum for some but not all students in a country, an item was determined appropriate if it was in the intended curriculum for more than 50% of the students. The NRCs had considerable flexibility in selecting items and may have considered items inappropriate for other reasons. All participating countries except Austria and Thailand returned the information for analysis.

---

[1] See Appendix A for more information on the test development.

[2] Because there also may be curriculum areas covered in some countries that are not covered by the TIMSS tests, the TCMA does not provide complete information about how well the TIMSS tests cover the curricula of the countries.

Tables B.1 and B.2 present the TCMA results for the fourth and third grades, respectively. The first row of each table indicates that at both grades the countries varied substantially in the number of items considered appropriate. At the fourth grade, two-thirds of the countries indicated that items representing three-quarters or more of the score points (85 out of a possible 113) were appropriate,[3] with the percentage ranging from 100% in the United States to 43% (49 score points) in Korea. Although, in general, fewer items were selected at the third grade than at the fourth grade, more than half of the countries selected items representing at least half of the score points (57). The number of score points represented by the selected items for the third grade ranged from 26 (23%) in the Netherlands to 113 (100%) in the United States. That somewhat lower percentages of items were selected for the TCMA at the third grade is consistent with the instrument development process, which put more emphasis on the upper-grade curriculum.

Since most countries indicated that some items were not included in their intended curricula at the two grades tested, the question becomes whether the inclusion of these items had any effect on the international performance comparisons.[4] The TCMA results provide a method for answering this question, providing evidence that the relative standings of countries generally do not vary much for the different sets of items selected from the TIMSS mathematics test.

The first column in Tables B.1 and B.2 shows the overall average percent correct for each country (as discussed in Chapter 2 and reproduced here for convenience in making comparisons). The countries are presented in the order of their overall performance, from highest to lowest. To interpret these tables, reading across a row provides the average percent correct for the students in that country on the items selected by each country, listed across the top of the table. For example, fourth-grade Japanese students had an average of 72% correct on the items Korea selected as appropriate for the Korean students, an average of 75% correct on the items selected for the Singaporean students, 75% correct on its own items, 74% on the items selected by Hong Kong, and so forth. The column for a country shows how each of the other countries performed on the subset of items selected for its own students. Using the set of items selected by Slovenia as an example, on average, 75% of these items were answered correctly by the Korean students, 74% by the Singaporean students, 73% by the Japanese students, 71% by the students from Hong Kong, 70% by Dutch students, and so forth. The shaded diagonal elements in each table show how each country performed on the subset of items that it selected based on its own curriculum. Thus, the Slovenian students themselves averaged 67% correct responses on the items identified by Slovenia for the analysis.

---

[3] Of the 102 items in the test, some items were assigned more score points than others. In particular, some items had two parts, and some extended-response items were scored on a two-point scale. The total number of score points available for analysis was 113. The TCMA uses the score points in order to give the same importance to items that they received in the test scoring.

[4] It should be noted that the performance levels presented in Tables B.1 and B.2 are based on the average percent correct as was done in Chapter 2, which is different from the average scale scores that were presented in Chapter 1. The cost and delay of scaling would have been prohibitive for the TCMA analyses.

Table B.1 Test-Curriculum Matching Analysis Results - Mathematics - Upper Grade (Fourth Grade*)

Average Percent Correct Based on Subsets of Items Specially Identified by Each Country as Addressing Its Curriculum (See Table B.3 for corresponding standard errors)

Instructions: Read ***across*** the row to compare that country's performance based on the test items included by each of the countries across the top.
Read ***down*** the column under a country name to compare the performance of the country down the left on the items included by the country listed on the top.
Read along the ***diagonal*** to compare performance for each different country based on its own decisions about the test items to include.

Country	*Average Percent Correct on all Items*	**Korea**	**Singapore**	**Japan**	**Hong Kong**	*Netherlands*	**Czech Republic**	*Slovenia*	*Hungary*	**Ireland**	*Australia*	**United States**	**Canada**	*Israel*	*Latvia (LSS)*	**Scotland**	**England**	**Cyprus**	**Norway**	**New Zealand**	**Greece**	**Iceland**	**Portugal**	**Iran, Islamic Rep.**	*Kuwait*
(Number of Score Points Included)	*113*	*49*	*84*	*101*	*91*	*59*	*84*	*89*	*96*	*86*	*111*	*113*	*99*	*83*	*105*	*92*	*86*	*99*	*100*	*98*	*92*	*73*	*102*	*97*	*66*
Korea	76 (0.4)	**77**	79	77	77	78	77	75	77	77	76	76	77	78	76	77	79	78	76	76	77	79	78	77	76
Singapore	76 (0.8)	75	**79**	76	77	78	76	74	75	77	75	76	77	77	75	76	78	78	75	75	77	78	77	76	78
Japan	74 (0.4)	72	75	**75**	74	76	75	73	75	75	74	74	75	75	74	74	77	74	75	74	75	77	75	74	74
Hong Kong	73 (0.8)	69	74	72	**73**	73	73	71	74	74	72	73	74	73	73	73	74	73	72	72	74	75	73	73	74
Netherlands	69 (0.7)	68	70	69	69	**75**	72	70	71	70	69	69	69	71	71	70	72	69	71	71	70	74	70	70	69
Czech Republic	66 (0.7)	66	67	66	67	71	**69**	68	68	67	66	66	66	69	68	66	68	66	67	68	67	71	67	67	66
Slovenia	64 (0.7)	65	65	64	65	68	68	**67**	67	65	64	64	65	67	66	64	66	64	66	67	66	69	65	65	64
Hungary	64 (0.8)	65	65	63	64	69	68	66	**66**	65	63	64	65	67	66	64	66	64	65	65	66	69	65	65	65
Ireland	63 (0.8)	61	65	64	65	67	65	63	65	**64**	63	63	65	64	64	65	66	64	64	64	64	67	64	64	64
Australia	63 (0.6)	59	63	62	64	65	64	64	65	62	**63**	63	63	64	64	64	65	63	63	64	63	67	63	63	61
United States	63 (0.7)	61	64	62	64	64	64	62	65	63	62	**63**	64	63	63	64	65	64	63	63	63	67	63	62	62
Canada	60 (1.0)	58	61	60	62	63	62	60	63	61	60	60	**61**	61	62	62	63	61	61	62	61	65	61	61	59
Israel	59 (1.0)	60	61	59	60	63	62	61	62	60	59	59	60	**62**	61	60	62	60	61	61	60	65	60	60	60
Latvia (LSS)	59 (1.0)	59	60	58	59	62	62	62	61	59	58	59	59	61	**60**	58	61	58	60	61	60	64	60	60	59
Scotland	58 (0.8)	55	58	57	59	60	59	58	60	58	58	58	59	59	59	**60**	61	59	58	60	58	63	59	58	55
England	57 (0.7)	52	56	56	57	58	58	57	59	56	56	57	57	57	58	59	**59**	57	57	59	56	61	57	56	53
Cyprus	54 (0.6)	55	55	54	55	57	56	54	55	55	53	54	55	55	54	54	56	**55**	55	55	56	57	55	56	57
Norway	53 (0.7)	53	53	53	53	57	56	55	55	53	53	53	53	55	55	53	55	53	**55**	56	54	57	54	54	52
New Zealand	53 (1.0)	49	53	52	54	55	55	54	56	53	53	53	54	54	55	55	55	54	54	**55**	53	58	54	53	51
Greece	51 (0.9)	50	51	50	52	55	53	52	52	52	50	51	51	52	52	50	52	51	52	52	**52**	54	52	52	53
Iceland	50 (0.8)	47	49	49	51	53	52	51	52	50	49	50	50	51	51	50	52	50	50	52	50	**55**	50	50	47
Portugal	48 (0.7)	47	49	47	48	50	49	49	49	50	48	48	49	49	48	47	49	48	48	48	50	50	**49**	49	50
Iran, Islamic Rep.	38 (0.9)	39	39	37	39	39	39	40	39	39	38	38	39	38	38	37	39	38	39	38	40	40	39	**40**	43
Kuwait	32 (0.5)	32	32	31	31	32	33	33	33	32	31	32	32	31	32	30	32	31	32	32	33	33	32	32	**33**
International Average	**59 (0.7)**	**58**	**60**	**59**	**60**	**62**	**61**	**60**	**61**	**60**	**59**	**59**	**60**	**61**	**60**	**60**	**61**	**60**	**60**	**60**	**60**	**63**	**60**	**60**	**59**

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
**Of the 102 items in the mathematics test, some items had two parts and some extended-response items were scored on a two-point scale, resulting in 113 total score points.
( ) Standard errors for the average percent of correct responses on all items appear in parentheses. Standard errors for scores based on subsets of items are provided in Table B.3.
Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).
Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table B.2 Test-Curriculum Matching Analysis Results - Mathematics - Lower Grade (Third Grade*)

Average Percent Correct Based on Subsets of Items Specially Identified by Each Country as Addressing Its Curriculum (See Table B.4 for corresponding standard errors)

Instructions: Read ***across*** the row to compare that country's performance based on the test items included by each of the countries across the top.
Read ***down*** the column under a country name to compare the performance of the country down the left on the items included by the country listed on the top.
Read along the ***diagonal*** to compare performance for each different country based on its own decisions about the test items to include.

Country	*Average Percent Correct on all Items*	**Korea**	**Japan**	**Singapore**	**Hong Kong**	*Netherlands*	**Czech Republic**	*Slovenia*	*Australia*	**United States**	*Hungary*	**Ireland**	**Canada**	*Scotland*	**England**	*Latvia (LSS)*	**New Zealand**	**Cyprus**	**Portugal**	**Greece**	**Norway**	**Iceland**	**Iran, Islamic Rep.**
	(Number of Score Points Included) 113	*69*	*84*	*58*	*45*	*26*	*61*	*80*	*63*	*113*	*74*	*41*	*63*	*46*	*54*	*51*	*71*	*77*	*102*	*51*	*81*	*34*	*65*
Korea	67 (0.5)	**65**	67	74	76	71	68	66	69	67	67	72	73	67	72	68	72	71	69	70	69	68	71
Japan	63 (0.3)	62	**64**	68	70	68	64	63	65	63	65	68	67	65	68	65	67	65	65	67	65	65	68
Singapore	62 (0.9)	61	64	**72**	72	69	63	62	65	62	63	67	66	64	69	61	68	68	64	68	65	65	67
Hong Kong	59 (0.7)	56	59	65	**69**	63	60	59	61	59	61	62	64	64	67	60	63	63	61	64	61	63	65
Netherlands	52 (0.6)	51	51	57	60	**63**	56	54	56	52	57	58	55	59	60	57	57	56	53	58	56	60	56
Czech Republic	52 (0.7)	50	50	58	61	60	**55**	55	53	52	56	59	55	58	60	57	57	55	53	57	55	61	58
Slovenia	51 (0.7)	49	49	56	61	58	55	**55**	53	51	56	58	55	59	58	56	57	55	52	56	54	59	56
Australia	50 (0.9)	47	48	54	58	58	52	51	**54**	50	54	54	55	58	57	54	55	54	50	55	53	57	53
United States	49 (0.7)	47	48	55	59	55	51	50	52	**49**	52	55	54	56	56	52	54	53	50	54	52	53	52
Hungary	49 (0.9)	47	48	56	61	58	52	52	51	49	**53**	58	53	55	55	54	55	53	50	54	52	55	55
Ireland	48 (0.8)	46	47	52	57	55	49	49	50	48	50	**55**	52	55	54	50	52	52	49	52	50	53	51
Canada	47 (0.7)	44	45	52	56	55	50	48	50	47	51	51	**53**	55	54	50	53	51	48	53	50	53	50
Scotland	45 (0.8)	42	43	48	53	53	48	46	49	45	49	48	50	**54**	53	48	50	49	46	50	47	51	47
England	45 (0.6)	43	43	48	52	52	47	46	48	45	49	47	48	53	**52**	48	49	49	45	49	47	51	47
Latvia (LSS)	45 (0.8)	43	43	51	53	50	48	47	47	45	49	51	49	52	51	**51**	51	49	46	50	47	54	50
New Zealand	41 (0.8)	39	39	45	49	47	43	42	44	41	45	44	45	49	47	45	**45**	45	41	46	43	48	44
Cyprus	38 (0.6)	36	39	46	46	43	39	39	39	38	39	45	42	43	43	40	43	**43**	39	44	40	42	43
Portugal	37 (0.8)	35	36	41	45	40	36	38	37	37	38	41	41	41	42	39	40	40	**38**	41	37	38	40
Greece	37 (0.8)	35	37	42	45	46	38	39	38	37	39	43	40	42	41	40	41	40	38	**44**	40	41	40
Norway	36 (0.7)	34	34	39	43	44	38	37	38	36	40	42	39	41	40	42	40	38	36	41	**38**	41	38
Iceland	35 (0.6)	34	34	38	42	43	37	37	38	35	39	40	40	43	40	39	40	39	36	40	38	**42**	38
Iran, Islamic Rep.	28 (0.7)	25	27	33	35	27	27	30	27	28	28	34	30	31	32	31	31	31	29	32	29	31	**33**
International Average	**47 (0.7)**	**45**	**46**	**52**	**56**	**54**	**49**	**48**	**49**	**47**	**50**	**52**	**51**	**53**	**53**	**50**	**52**	**51**	**48**	**52**	**49**	**52**	**51**

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.

**Of the 102 items in the mathematics test, some items had two parts and some extended-response items were scored on a two-scale, resulting in 113 total score points.

( ) Standard errors for the average percent of correct responses on all items appear in parentheses. Standard errors for scores based on subsets of items are provided in Table B.4.

Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).

Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

The international averages presented across the last row of the tables show that the selection of items for the participating countries varied somewhat in average difficulty, ranging from 58% to 63% at the fourth grade and from 45% to 56% at the third grade. Despite these differences, the overall picture provided by Tables B.1 and B.2 reveals that different item selections do not make a major difference in how well countries perform relative to each other. The items selected by some countries were more difficult than those selected by others. The relative performance of countries on the various item selections did vary somewhat, but generally not in a statistically significant manner.[5]

Comparing the diagonal element for a country with the overall average percentage correct shows the difference between performance on this subset of items and performance on the test as a whole. In general, there were small increases in each country's performance on its own subset of items. To illustrate, the average percent correct for fourth-grade students in Ireland is 63%. The diagonal element shows that Irish students had about the same average percent correct (64%) based on the smaller set of items selected as relevant to the curriculum in Ireland as they did overall. In the fourth grade, the differences were 3 average percentage points or less for most countries. Only a few countries had an average percent correct on their own selected items that was more than 4 percentage points higher than their average on the test as a whole. Performance differences between the entire TIMSS test and the subset of items selected for the TCMA were, in general, somewhat larger for third-grade students. Several countries had average performance that was about 10 percentage points higher on the items selected for their own students. The largest increase (11 average percentage points) was for the third-grade students in the Netherlands.

It is clear that the selection of items does not have a major effect on the general relationships among countries. Countries that had substantially higher or lower performance on the overall test in comparison to each other also had higher or lower relative performance on the different sets of items selected for the TCMA. At the fourth grade, Korea, Singapore, Japan, and Hong Kong were the highest-performing countries, both on the test as a whole and on all the different sets of item selections. At the third grade, Korea had the highest average percent correct on the test as a whole and on all of the different item selections, with Japan, Singapore and Hong Kong among the top four highest-performing countries in all cases. Although there were some changes in the ordering of countries based on the items selected for the TCMA, most of these differences are within the boundaries of sampling error.

---

[5] Small differences in performance in these tables are not statistically significant. The standard errors for the estimated average percent correct statistics can found in Tables B.3 and B.4. We can say with 95% confidence that the value for the entire population will fall between the sample estimate plus or minus two standard errors.

As the most extreme example, consider the 26 score points selected by the Netherlands for the third grade. The Netherlands did substantially better on these items than on the test as a whole, with 63% correct responses to these items, on average, compared to only 52% average correct on the test as a whole. However, almost all other countries also did better on these particular items, with an international average of 54% for the items selected by the Netherlands compared with 47% on the test as a whole. Insofar as countries rejected items that would be difficult for their own students, these items tended to be difficult for students in other countries as well. The analysis shows that omitting such items improves the results for that country, but also tends to improve the results for all other countries, so that the overall pattern of results is largely unaffected.

Table B.3 Standard Errors for the Test-Curriculum Matching Analysis Results Mathematics - Upper Grade (Fourth Grade*)

See Table B.1 for the Test-Curriculum Matching Analysis Results

Instructions: Read ***across*** the row for the standard error for the score based on the test items included by each of the countries across the top.
Read ***down*** the column under a country name for the standard error for the score of the country down the left on the items included by the country listed on the top.
Read along the ***diagonal*** for the standard error for the score for each different country based on its own decisions about the test items to include.

Country	*Average Percent Correct on all Items*	**Korea**	**Singapore**	**Japan**	**Hong Kong**	*Netherlands*	**Czech Republic**	*Slovenia*	*Hungary*	**Ireland**	*Australia*	**United States**	**Canada**	*Israel*	*Latvia (LSS)*	**Scotland**	**England**	**Cyprus**	**Norway**	**New Zealand**	**Greece**	**Iceland**	**Portugal**	**Iran, Islamic Rep.**	*Kuwait*
(Number of Score Points Included)	*113*	*49*	*84*	*101*	*91*	*59*	*84*	*89*	*96*	*86*	*111*	*113*	*99*	*83*	*105*	*92*	*86*	*99*	*100*	*98*	*92*	*73*	*102*	*97*	*66*
Korea	76 (0.4)	**0.4**	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Singapore	76 (0.8)	0.9	**0.8**	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Japan	74 (0.4)	0.5	0.4	**0.4**	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Hong Kong	73 (0.8)	0.9	0.9	0.9	**0.9**	0.9	0.9	0.9	0.8	0.8	0.9	0.8	0.9	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.9	0.9
Netherlands	69 (0.7)	0.8	0.7	0.7	0.7	**0.7**	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Czech Republic	66 (0.7)	0.7	0.6	0.7	0.6	0.7	**0.6**	0.6	0.7	0.6	0.7	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.6	0.7	0.6	0.7	0.6	0.6	0.6
Slovenia	64 (0.7)	0.7	0.7	0.7	0.7	0.7	0.6	**0.6**	0.6	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.6	0.6	0.6	0.6	0.7
Hungary	64 (0.8)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	**0.8**	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7
Ireland	63 (0.8)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	**0.8**	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.7	0.8	0.8	0.8
Australia	63 (0.6)	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	**0.6**	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
United States	63 (0.7)	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.7	**0.7**	0.7	0.6	0.6	0.7	0.7	0.7	0.6	0.7	0.6	0.6	0.6	0.7	0.6
Canada	60 (1.0)	1.0	1.0	1.1	1.0	1.1	1.1	1.0	1.1	1.0	1.1	1.0	**1.1**	1.0	1.1	1.1	1.1	1.1	1.0	1.1	1.0	1.1	1.0	1.0	0.9
Israel	59 (1.0)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	**1.0**	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Latvia (LSS)	59 (1.0)	1.0	1.0	1.0	1.0	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	**1.0**	1.0	1.0	1.0	0.9	0.9	1.0	0.9	0.9	0.9	1.0
Scotland	58 (0.8)	0.8	0.9	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	**0.8**	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9
England	57 (0.7)	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	**0.7**	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7
Cyprus	54 (0.6)	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.7	**0.6**	0.6	0.7	0.6	0.7	0.7	0.7	0.6
Norway	53 (0.7)	0.8	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7	**0.7**	0.7	0.6	0.7	0.6	0.7	0.6
New Zealand	53 (1.0)	0.9	1.0	1.0	0.9	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	**1.0**	1.0	1.0	1.0	0.9	1.0
Greece	51 (0.9)	1.0	1.0	0.9	0.9	1.0	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	1.0	1.0	0.9	0.9	0.9	**0.9**	1.0	0.9	0.9	1.0
Iceland	50 (0.8)	0.9	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	**0.8**	0.8	0.8	0.8
Portugal	48 (0.7)	0.7	0.8	0.7	0.8	0.8	0.8	0.7	0.7	0.8	0.7	0.7	0.8	0.8	0.7	0.8	0.8	0.8	0.7	0.7	0.8	0.8	**0.8**	0.7	0.7
Iran, Islamic Rep.	38 (0.9)	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	**1.0**	1.0
Kuwait	32 (0.5)	0.6	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**0.5**
International Average	**59 (0.7)**	**0.8**	**0.8**	**0.8**	**0.7**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.8**	**0.7**	**0.7**	**0.7**

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

**Of the 102 items in the mathematics test, some items had two parts and some extended-response items were scored on a two-point scale, resulting in 113 total score points.

( ) Standard errors for the average percent of correct responses on all items appear in parentheses. The matrix contains standard errors corresponding to the average percent of correct responses based on TCMA subsets of items, as displayed in Table B.1. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).

Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table B.4 Standard Errors for the Test-Curriculum Matching Analysis Results Mathematics - Lower Grade (Third Grade*)

See Table B.3 for the Test-Curriculum Matching Analysis Results

Instructions: Read ***across*** the row for the standard error for the score based on the test items included by each of the countries across the top.

Read ***down*** the column under a country name for the standard error for the score of the country down the left on the items included by the country listed on the top.

Read along the ***diagonal*** for the standard error for the score for each different country based on its own decisions about the test items to include.

Country	*Average Percent Correct on all Items*	**Korea**	**Japan**	**Singapore**	**Hong Kong**	*Netherlands*	**Czech Republic**	*Slovenia*	*Australia*	**United States**	*Hungary*	**Ireland**	**Canada**	*Scotland*	**England**	*Latvia (LSS)*	**New Zealand**	**Cyprus**	**Portugal**	**Greece**	**Norway**	**Iceland**	**Iran, Islamic Rep.**
	(Number of Score Points Included)																						
	113	***69***	***84***	***58***	***45***	***26***	***61***	***80***	***63***	***113***	***74***	***41***	***63***	***46***	***54***	***51***	***71***	***77***	***102***	***51***	***81***	***34***	***65***
Korea	67 (0.5)	**0.5**	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Japan	63 (0.3)	0.4	**0.3**	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.3	0.4	0.3	0.4	0.3	0.4	0.4
Singapore	62 (0.9)	1.0	0.9	**0.9**	0.9	0.9	1.0	1.0	1.0	0.9	1.0	0.9	0.9	0.9	0.8	1.0	0.9	0.9	0.9	0.9	0.9	1.0	0.9
Hong Kong	59 (0.7)	0.8	0.8	0.7	**0.7**	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7
Netherlands	52 (0.6)	0.6	0.6	0.7	0.6	**0.7**	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.7	0.6	0.6	0.6	0.6	0.7	0.7
Czech Republic	52 (0.7)	0.7	0.7	0.7	0.7	0.8	**0.8**	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7
Slovenia	51 (0.7)	0.7	0.7	0.8	0.7	0.8	0.8	**0.7**	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.8	0.7
Australia	50 (0.9)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	**0.9**	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
United States	49 (0.7)	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	**0.7**	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.7
Hungary	49 (0.9)	0.8	0.8	0.9	1.0	0.9	1.0	0.9	0.9	0.9	**0.9**	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	1.0	0.9	1.0	0.9
Ireland	48 (0.8)	0.8	0.8	0.8	0.9	1.0	0.8	0.8	0.8	0.8	0.8	**0.8**	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.7
Canada	47 (0.7)	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.7	**0.8**	0.9	0.8	0.8	0.7	0.8	0.7	0.7	0.7	0.8	0.7
Scotland	45 (0.8)	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.8	**0.8**	0.9	0.8	0.8	0.8	0.8	0.9	0.8	0.9	0.8
England	45 (0.6)	0.6	0.6	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.7	0.7	0.7	0.6	**0.7**	0.6	0.7	0.7	0.6	0.6	0.6	0.7	0.7
Latvia (LSS)	45 (0.8)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.9	0.8	0.8	0.9	**0.8**	0.8	0.8	0.8	0.8	0.9	0.9	0.9
New Zealand	41 (0.8)	0.9	0.8	0.9	1.0	1.0	0.9	0.9	1.0	0.8	0.9	0.9	1.0	1.0	0.9	0.8	**0.9**	0.9	0.8	0.9	0.9	1.0	0.9
Cyprus	38 (0.6)	0.6	0.6	0.7	0.7	0.7	0.6	0.6	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.7	**0.6**	0.6	0.7	0.6	0.7	0.6
Portugal	37 (0.8)	0.8	0.8	0.9	1.0	1.0	0.9	0.8	0.9	0.8	0.9	0.8	1.0	0.9	1.0	0.9	0.9	0.9	**0.8**	0.9	0.8	1.0	0.9
Greece	37 (0.8)	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.8	0.8	1.0	0.9	0.9	0.9	0.8	0.9	0.9	0.8	**0.9**	0.8	0.9	0.9
Norway	36 (0.7)	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.8	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.7	**0.7**	0.8	0.7
Iceland	35 (0.6)	0.6	0.6	0.7	0.7	0.8	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.7	0.6	0.6	0.6	**0.9**	0.7
Iran, Islamic Rep.	28 (0.7)	0.7	0.7	0.9	1.0	0.8	0.7	0.7	0.7	0.7	0.7	0.9	0.8	0.7	0.8	0.7	0.8	0.8	0.7	0.8	0.7	0.8	**0.9**
International Average	**47 (0.7)**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.8**	**0.7**	**0.8**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.8**	**0.7**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.8**

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.

**Of the 102 items in the mathematics test, some items had two parts and some extended-response items were scored on a two-point scale, resulting in 113 total score points.

( ) Standard errors for the average percent of correct responses on all items appear in parentheses. The matrix contains standard errors corresponding to the average percent of correct responses based on TCMA subsets of items, as displayed in Table B.2. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).

Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Appendix C

PERCENTILES AND STANDARD DEVIATIONS OF MATHEMATICS ACHIEVEMENT

229

Table C.1

Percentiles of Achievement in Mathematics Upper Grade (Fourth Grade*)

Country	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Australia	**394 (5.4)**	**486 (2.9)**	**546 (2.9)**	**608 (2.9)**	**696 (3.5)**
Austria	420 (7.2)	508 (5.0)	560 (3.4)	613 (3.5)	687 (5.1)
Canada	394 (4.7)	477 (5.3)	533 (3.7)	588 (3.0)	670 (8.2)
Cyprus	362 (5.9)	440 (5.1)	503 (3.2)	563 (3.7)	645 (3.7)
Czech Republic	427 (4.0)	509 (3.9)	566 (3.2)	626 (2.6)	711 (6.2)
England	366 (2.9)	452 (3.4)	509 (4.3)	569 (4.5)	672 (3.2)
Greece	341 (10.5)	435 (5.6)	492 (4.3)	553 (6.3)	637 (4.6)
Hong Kong	450 (5.3)	536 (4.4)	590 (5.1)	640 (4.0)	710 (7.4)
Hungary	404 (4.0)	488 (3.8)	548 (4.0)	607 (4.7)	695 (5.5)
Iceland	359 (4.4)	424 (3.7)	471 (2.6)	519 (2.7)	595 (10.7)
Iran, Islamic Rep.	320 (4.9)	382 (3.0)	425 (3.4)	472 (3.3)	546 (5.2)
Ireland	401 (10.2)	495 (4.0)	553 (3.9)	610 (4.2)	687 (5.1)
Israel	392 (5.0)	477 (3.3)	531 (6.4)	590 (3.9)	665 (7.0)
Japan	458 (2.6)	545 (3.2)	597 (2.4)	653 (1.6)	726 (1.5)
Korea	489 (6.3)	565 (2.2)	613 (2.3)	661 (2.4)	727 (4.2)
Kuwait	295 (5.9)	356 (2.8)	399 (3.0)	444 (3.3)	513 (4.1)
Latvia (LSS)	392 (8.2)	465 (6.2)	522 (4.0)	582 (8.0)	664 (12.3)
Netherlands	462 (2.7)	528 (4.8)	575 (3.2)	625 (5.2)	690 (5.4)
New Zealand	350 (9.0)	440 (7.5)	500 (4.5)	560 (3.7)	641 (7.1)
Norway	376 (2.8)	454 (4.9)	506 (1.9)	550 (3.3)	623 (2.0)
Portugal	340 (4.4)	424 (4.5)	476 (4.7)	531 (2.9)	605 (3.1)
Scotland	373 (6.6)	460 (5.7)	520 (3.9)	581 (3.7)	667 (5.7)
Singapore	436 (5.9)	561 (6.7)	631 (5.8)	697 (6.6)	788 (7.2)
Slovenia	419 (6.1)	497 (3.4)	552 (4.4)	609 (3.1)	690 (2.5)
Thailand	375 (6.9)	444 (5.2)	492 (6.4)	538 (5.0)	603 (9.7)
United States	398 (3.1)	488 (2.5)	548 (2.9)	603 (3.3)	682 (3.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table C.2

Percentiles of Achievement in Mathematics Lower Grade (Third Grade*)

Country	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Australia	336 (5.4)	422 (4.6)	485 (3.9)	541 (3.8)	636 (4.5)
Austria	357 (4.4)	430 (4.7)	485 (3.3)	538 (4.7)	625 (28.7)
Canada	341 (5.0)	416 (2.4)	472 (4.5)	524 (3.1)	596 (4.2)
Cyprus	305 (6.1)	378 (2.2)	428 (3.2)	483 (2.9)	557 (5.8)
Czech Republic	363 (3.7)	441 (2.7)	496 (2.8)	553 (3.1)	638 (6.2)
England	318 (4.0)	396 (4.9)	455 (2.7)	515 (5.0)	603 (4.1)
Greece	290 (3.0)	371 (4.1)	429 (5.3)	484 (5.3)	574 (9.5)
Hong Kong	403 (4.6)	478 (4.2)	529 (3.3)	573 (4.5)	637 (2.9)
Hungary	330 (5.7)	418 (4.6)	476 (5.0)	537 (5.3)	620 (6.6)
Iceland	301 (2.4)	364 (3.2)	410 (2.4)	454 (2.6)	518 (7.3)
Iran, Islamic Rep.	272 (4.8)	334 (3.9)	377 (2.9)	419 (5.8)	492 (8.6)
Ireland	342 (6.8)	418 (5.5)	477 (4.2)	530 (3.5)	610 (2.2)
Israel	- -	- -	- -	- -	- -
Japan	410 (3.5)	489 (2.4)	538 (1.1)	590 (2.5)	659 (2.8)
Korea	445 (2.6)	516 (3.0)	564 (2.7)	607 (3.7)	677 (5.0)
Kuwait	- -	- -	- -	- -	- -
Latvia (LSS)	337 (3.1)	409 (4.4)	459 (5.6)	514 (4.9)	601 (12.1)
Netherlands	387 (7.4)	449 (3.9)	492 (3.8)	536 (4.0)	601 (3.3)
New Zealand	300 (12.3)	388 (4.2)	442 (5.4)	495 (3.7)	573 (3.9)
Norway	303 (3.8)	374 (3.6)	422 (2.4)	469 (3.7)	541 (7.6)
Portugal	280 (5.9)	370 (4.8)	428 (4.8)	481 (4.7)	565 (4.3)
Scotland	328 (3.3)	407 (3.6)	456 (3.0)	510 (4.9)	591 (5.3)
Singapore	378 (3.3)	488 (4.4)	556 (5.3)	620 (6.4)	709 (8.0)
Slovenia	362 (2.6)	434 (4.6)	485 (3.0)	541 (3.6)	616 (3.8)
Thailand	328 (4.2)	395 (3.9)	445 (4.5)	494 (6.4)	561 (6.3)
United States	346 (5.0)	423 (3.9)	479 (2.7)	536 (3.9)	616 (12.3)

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
A dash (-) indicates data are not available. Israel and Kuwait did not test the lower grade.
( ) Standard errors appear in parentheses.
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table C.3

Standard Deviations of Achievement in Mathematics Upper Grade (Fourth Grade*)

Country	Overall		Boys		Girls	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Australia	546 (3.1)	92 (1.7)	547 (3.5)	93 (1.9)	545 (3.7)	91 (1.9)
Austria	559 (3.1)	79 (1.3)	563 (3.6)	79 (1.7)	555 (3.6)	79 (1.5)
Canada	532 (3.3)	84 (1.7)	534 (3.4)	86 (1.9)	531 (3.9)	82 (2.1)
Cyprus	502 (3.1)	86 (1.5)	506 (3.5)	89 (2.0)	499 (3.3)	83 (1.9)
Czech Republic	567 (3.3)	86 (1.7)	568 (3.4)	86 (2.1)	566 (3.6)	86 (2.1)
England	513 (3.2)	91 (2.0)	515 (3.4)	93 (1.9)	510 (4.4)	90 (3.2)
Greece	492 (4.4)	90 (3.0)	491 (5.0)	91 (3.5)	493 (4.5)	88 (3.0)
Hong Kong	587 (4.3)	79 (1.8)	586 (4.7)	81 (2.4)	587 (4.2)	76 (1.6)
Hungary	548 (3.7)	88 (1.7)	552 (4.2)	90 (2.1)	546 (3.9)	85 (2.2)
Iceland	474 (2.7)	72 (1.5)	474 (3.3)	72 (1.8)	473 (3.0)	72 (2.0)
Iran, Islamic Rep.	429 (4.0)	69 (2.1)	433 (6.0)	72 (3.3)	424 (5.0)	66 (2.3)
Ireland	550 (3.4)	85 (1.6)	548 (3.9)	88 (1.9)	551 (4.3)	83 (2.0)
Israel	531 (3.5)	85 (1.8)	537 (4.4)	82 (2.2)	528 (4.1)	86 (2.3)
Japan	597 (2.1)	81 (0.9)	601 (2.5)	85 (1.4)	593 (2.2)	77 (1.1)
Korea	611 (2.1)	74 (1.3)	618 (2.5)	75 (1.9)	603 (2.6)	72 (1.7)
Kuwait	400 (2.8)	67 (1.2)	399 (4.6)	72 (1.9)	402 (2.5)	61 (1.6)
Latvia (LSS)	525 (4.8)	85 (3.4)	521 (5.5)	87 (4.4)	530 (5.2)	82 (3.1)
Netherlands	577 (3.4)	71 (1.6)	585 (3.8)	71 (2.0)	569 (3.4)	69 (1.6)
New Zealand	499 (4.3)	90 (2.5)	494 (5.7)	95 (3.4)	504 (4.3)	83 (2.3)
Norway	502 (3.0)	74 (1.5)	504 (3.5)	76 (2.0)	499 (3.6)	71 (1.7)
Portugal	475 (3.5)	80 (1.7)	478 (3.8)	81 (1.9)	473 (3.7)	79 (2.1)
Scotland	520 (3.9)	89 (1.9)	520 (4.3)	92 (2.4)	520 (3.8)	86 (2.1)
Singapore	625 (5.3)	104 (2.3)	620 (5.5)	107 (2.4)	630 (6.4)	101 (2.9)
Slovenia	552 (3.2)	82 (1.7)	551 (3.4)	83 (1.9)	554 (4.0)	82 (2.4)
Thailand	490 (4.7)	70 (2.0)	485 (5.8)	70 (2.5)	496 (4.2)	69 (2.1)
United States	545 (3.0)	85 (1.4)	545 (3.1)	86 (1.4)	544 (3.3)	84 (1.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table C.4

Standard Deviations of Achievement in Mathematics Lower Grade (Third Grade*)

Country	Overall		Boys		Girls	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Australia	483 (4.0)	90 (1.7)	487 (4.5)	91 (2.3)	480 (4.4)	89 (2.1)
Austria	487 (5.3)	83 (5.5)	494 (9.2)	90 (8.4)	481 (3.8)	75 (2.0)
Canada	469 (2.7)	78 (1.4)	477 (3.2)	80 (1.8)	463 (3.0)	76 (1.3)
Cyprus	430 (2.8)	77 (1.6)	433 (3.3)	81 (2.0)	428 (3.1)	73 (1.9)
Czech Republic	497 (3.3)	83 (1.9)	502 (3.7)	84 (2.2)	493 (3.8)	81 (2.1)
England	456 (3.0)	87 (1.7)	461 (3.5)	90 (1.8)	452 (3.4)	84 (2.2)
Greece	428 (4.0)	85 (2.1)	432 (4.4)	85 (2.6)	424 (4.2)	85 (2.3)
Hong Kong	524 (3.0)	72 (1.6)	528 (3.2)	75 (1.8)	518 (3.5)	69 (2.0)
Hungary	476 (4.2)	89 (2.0)	479 (4.9)	91 (2.7)	476 (4.4)	87 (2.1)
Iceland	410 (2.8)	67 (1.5)	418 (3.5)	72 (2.4)	403 (3.0)	62 (1.5)
Iran, Islamic Rep.	378 (3.5)	66 (2.1)	384 (4.4)	67 (2.3)	373 (4.9)	64 (3.2)
Ireland	476 (3.6)	81 (1.7)	473 (4.3)	84 (1.9)	479 (4.5)	78 (2.3)
Israel	- -	- -	- -	- -	- -	- -
Japan	538 (1.5)	75 (1.1)	539 (2.0)	77 (1.5)	536 (1.7)	73 (1.3)
Korea	561 (2.3)	70 (1.0)	567 (2.8)	71 (1.5)	554 (2.5)	68 (1.2)
Kuwait	- -	- -	- -	- -	- -	- -
Latvia (LSS)	463 (4.3)	81 (3.9)	462 (5.3)	82 (4.7)	464 (4.5)	80 (3.8)
Netherlands	493 (2.7)	65 (1.4)	497 (2.9)	65 (1.5)	489 (3.2)	64 (2.0)
New Zealand	440 (4.0)	82 (2.5)	436 (4.4)	83 (2.3)	443 (4.5)	81 (3.5)
Norway	421 (3.1)	72 (1.4)	430 (3.5)	71 (1.8)	411 (3.8)	71 (1.9)
Portugal	425 (3.8)	85 (2.1)	430 (3.5)	85 (2.3)	420 (5.0)	85 (3.6)
Scotland	458 (3.4)	80 (2.0)	462 (3.8)	81 (2.4)	454 (3.5)	78 (2.3)
Singapore	552 (4.8)	100 (2.2)	551 (5.4)	104 (2.5)	553 (5.0)	96 (2.4)
Slovenia	488 (2.9)	77 (1.6)	492 (3.1)	79 (1.6)	483 (3.5)	75 (2.3)
Thailand	444 (5.1)	71 (2.5)	440 (5.0)	71 (2.7)	448 (5.6)	71 (2.8)
United States	480 (3.4)	82 (2.2)	480 (3.1)	82 (2.3)	479 (4.4)	82 (2.4)

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
A dash (-) indicates data are not available. Israel and Kuwait did not test the lower grade.
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Appendix D

ACKNOWLEDGMENTS

TIMSS was truly a collaborative effort among hundreds of individuals around the world. Staff from the national research centers, the international management, advisors, and funding agencies worked closely to design and implement the most ambitious study of international comparative achievement ever undertaken. TIMSS would not have been possible without the tireless efforts of all involved. Below, the individuals and organizations are acknowledged for their contributions. Given that implementing TIMSS has spanned more than seven years and involved so many people and organizations, this list may not pay heed to all who contributed throughout the life of the project. Any omission is inadvertent. TIMSS also acknowledges the students, teachers, and school principals who contributed their time and effort to the study. This report would not be possible without them.

MANAGEMENT AND OPERATIONS

Since 1993, TIMSS has been directed by the International Study Center at Boston College in the United States. Prior to this, the study was coordinated by the International Coordinating Center at the University of British Columbia in Canada. Although the study was directed centrally by the International Study Center and its staff members implemented various parts of TIMSS, important activities also were carried out in centers around the world. The data were processed centrally by the IEA Data Processing Center in Hamburg, Germany. Statistics Canada was responsible for collecting and evaluating the sampling documentation from each country and for calculating the sampling weights. The Australian Council for Educational Research conducted the scaling of the achievement data.

INTERNATIONAL STUDY CENTER (1993-)

Albert E. Beaton, International Study Director
Michael O. Martin, Deputy International Study Director
Ina V.S. Mullis, Co-Deputy International Study Director
Eugenio J. Gonzalez, Director of Operations and Data Analysis
Dana L. Kelly, Research Associate
Teresa A. Smith, Research Associate
Maryellen Harmon, Performance Assessment Coordinator
Robert Jin, Computer Programmer
Ce Shen, Computer Programmer
William J. Crowley, Fiscal Administrator
Thomas M. Hoffmann, Art Director
Jonathan R. English, Systems Manager
José Rafael Nieto, Senior Production Specialist
Ann G.A. Tan, Conference Coordinator
Mary C. Howard, Office Supervisor
Cheryl L. Flaherty, Secretary

234

INTERNATIONAL STUDY CENTER (CONTINUED)

Diane Joyce, Secretary
Kathleen A. Haley, Graduate Assistant
Craig D. Hoyle, Graduate Assistant

INTERNATIONAL COORDINATING CENTER (1991-93)

David F. Robitaille, International Coordinator
Robert A. Garden, Deputy International Coordinator
Barry Anderson, Director of Operations
Beverley Maxwell, Director of Data Management

STATISTICS CANADA

Pierre Foy, Senior Methodologist
Suzelle Giroux, Senior Methodologist
Jean Dumais, Senior Methodologist
Nancy Darcovich, Senior Methodologist
Marc Joncas, Senior Methodologist
Laurie Reedman, Junior Methodologist
Claudio Perez, Junior Methodologist

IEA DATA PROCESSING CENTER

Michael Bruneforth, Senior Researcher
Jedidiah Harris, Research Assistant
Dirk Hastedt, Senior Researcher
Heiko Jungclaus, Senior Researcher
Svenja Moeller, Research Assistant
Knut Schwippert, Senior Researcher
Jockel Wolff, Research Assistant

AUSTRALIAN COUNCIL FOR EDUCATIONAL RESEARCH

Raymond J. Adams, Principal Research Fellow
Margaret Wu, Research Fellow
Nikolai Volodin, Research Fellow
David Roberts, Research Officer
Greg Macaskill, Research Officer

FUNDING AGENCIES

Funding for the International Study Center was provided by the National Center for Education Statistics of the U.S. Department of Education, the U.S. National Science Foundation, and the International Association for the Evaluation for Educational Achievement. Eugene Owen and Lois Peak of the National Center for Education Statistics and Larry Suter of the National Science Foundation each played a crucial role in making TIMSS possible and for ensuring the quality of the study. Funding for the International Coordinating Center was provided by the Applied Research Branch of the Strategic Policy Group of the Canadian Ministry of Human Resources Development. This initial source of funding was vital to initiate the TIMSS project. Tjeerd Plomp, Chair of the IEA and of the TIMSS Steering Committee, has been a constant source of support throughout TIMSS. It should be noted that each country provided its own funding for the implementation of the study at the national level.

NATIONAL RESEARCH COORDINATORS

The TIMSS National Research Coordinators and their staff had the enormous task of implementing the TIMSS design in their countries. This required obtaining funding for the project; participating in the development of the instruments and procedures; conducting field tests; participating in and conducting training sessions; translating the instruments and procedural manuals into the local language; selecting the sample of schools and students; working with the schools to arrange for the testing; arranging for data collection, coding, and data entry; preparing the data files for submission to the IEA Data Processing Center; contributing to the development of the international reports; and preparing national reports. The way in which the national centers operated and the resources that were available varied considerably across the TIMSS countries. In some countries, the tasks were conducted centrally, while in others, various components were subcontracted to other organizations. In some countries, resources were more than adequate, while in others, the national centers were operating with limited resources. Of course, across the life of the project, some NRCs have changed. This list attempts to include all past NRCs who served for a significant period of time as well as all the present NRCs. All of the TIMSS National Research Coordinators and their staff members are to be commended for their professionalism and their dedication in conducting all aspects of TIMSS.

Argentina
Carlos Mansilla
Universidad del Chaco
Av. Italia 350
3500 Resistencia
Chaco, Argentina

Australia
Jan Lokan
Raymond Adams *
Australian Council for Educational Research
19 Prospect Hill
Private Bag 55
Camberwell, Victoria 3124
Australia

---

* Past National Research Coordinator

Austria
Guenter Haider
Austrian IEA Research Centre
Universität Salzburg
Akademiestraße 26/2
A-5020 Salzburg, Austria

Belgium (Flemish)
Christiane Brusselmans-Dehairs
Rijksuniversiteit Ghent
Vakgroep Onderwijskunde &
The Ministry of Education
Henri Dunantlaan 2
B-9000 Ghent, Belgium

Belgium (French)
Georges Henry
Christian Monseur
Universite de Liège
B32 Sart-Tilman
4000 Liège 1, Belgium

Bulgaria
Kiril Bankov
Foundation for Research, Communication,
Education and Informatics
Tzarigradsko Shausse 125, Bl. 5
1113 Sofia, Bulgaria

Canada
Alan Taylor
Applied Research & Evaluation Services
University of British Columbia
2125 Main Mall
Vancouver, B.C. V6T 1Z4
Canada

Colombia
Carlos Jairo Diaz
Universidad del Valle
Facultad de Ciencias
Multitaller de Materiales Didacticos
Ciudad Universitaria Meléndez
Apartado Aereo 25360
Cali, Colombia

Cyprus
Constantinos Papanastasiou
Department of Education
University of Cyprus
Kallipoleos 75
P.O. Box 537
Nicosia 133, Cyprus

Czech Republic
Jana Strakova
Vladislav Tomasek
Institute for Information on Education
Senovazne Nam. 26
111 21 Praha 1, Czech Republic

Denmark
Peter Weng
Peter Allerup
Borge Prien*
The Danish National Institute for
Educational Research
28 Hermodsgade
Dk-2200 Copenhagen N, Denmark

England
Wendy Keys
Derek Foxman*
National Foundation for
Educational Research
The Mere, Upton Park
Slough, Berkshire SL1 2DQ
England

France
Anne Servant
Ministère de l'Education
Nationale 142, rue du Bac
75007 Paris, France

Josette Le Coq*
Centre International d'Etudes
Pédagogiques (CIEP)
1 Avenue Léon Journault
93211 Sèvres, France

Germany
Rainer Lehmann
Humboldt-Universitaet zu Berlin
Institut Fuer Allgemeine
Erziehungswissenschaft
Geschwister-Scholl-Str. 6
10099 Berlin, Germany

Juergen Baumert
Max-Planck Institute for Human
Development and Education
Lentzeallee 94
14191 Berlin, Germany

Manfred Lehrke
Universität Kiel
IPN Olshausen Str. 62
24098 Kiel, Germany

Greece
Georgia Kontogiannopoulou-Polydorides
Department of Education (Nipiagogon)
University of Athens
Navarinou 13A, Neochimio
Athens 10680, Greece

Joseph Solomon
Department of Education
University of Patras
Patras 26500, Greece

Hong Kong
Frederick Leung
Nancy Law
The University of Hong Kong
Department of Curriculum Studies
Pokfulam Road, Hong Kong

Hungary
Péter Vari
National Institute of Public Education
Centre for Evaluation Studies
Dorottya U. 8, P.O. Box 120
1051 Budapest, Hungary

Iceland
Einar Gudmundsson
Institute for Educational Research
Department of Educational Testing
and Measurement
Surdgata 39
101 Reykjavik, Iceland

Indonesia
Jahja Umar
Ministry of Education and Culture
Examination Development Center
Jalan Gunung Sahari - 4
Jakarta 10000, Indonesia

Ireland
Deirdre Stuart
Michael Martin*
Educational Research Centre
St. Patrick's College
Drumcondra
Dublin 9, Ireland

Iran, Islamic Republic
Ali Reza Kiamanesh
Ministry of Education
Center for Educational Research
Iranshahr Shomali Avenue
Teheran 15875, Iran

Israel
Pinchas Tamir
The Hebrew University
Israel Science Teaching Center
Jerusalem 91904, Israel

Ruth Zuzovsky
Tel Aviv university
School of Education
Ramat Aviv
PO Box 39040
Tel Aviv 69978, Israel

Italy
Anna Maria Caputo
Ministero della Pubblica Istruzione
Centro Europeo dell'Educazione
Villa Falconieri
00044 Frascati, Italy

Japan
Masao Miyake
Eizo Nagasaki
National Institute for Educational Research
6-5-22 Shimomeguro
Meguro-Ku, Tokyo 153, Japan

Korea
Jingyu Kim
Hyung Im*
National Board of Educational Evaluation
Evaluation Research Division
Chungdam-2 Dong 15-1, Kangnam-Ku
Seoul 135-102, Korea

Kuwait
Mansour Hussein
Ministry of Education
P. O. Box 7
Safat 13001, Kuwait

Latvia
Andrejs Geske
University of Latvia
Faculty of Education & Psychology
Jurmalas Gatve 74/76, Rm. 204a
Riga, Lv-1083, Latvia

Lithuania
Algirdas Zabulionis
University of Vilnius
Faculty of Mathematics
Naugarduko 24
2006 Vilnius, Lithuania

Mexico
Fernando Córdova Calderón
Director de Evaluación de Politicas y
Sistemas Educativos
Netzahualcoyotl #127 2ndo Piso
Colonia Centro
Mexico 1, D.F., Mexico

Netherlands
Wilmad Kuiper
Megan Chamberlain
Anja Knuver
Klaas Bos
University of Twente
Faculty of Educational Science
and Technology
Department of Curriculum
P.O. Box 217
7500 AE Enschede, Netherlands

New Zealand
Hans Wagemaker
Steve May
Ministry of Education
Research and International Section
P.O. Box 1666
45-47 Pipitea Street
Wellington, New Zealand

Norway
Svein Lie
University of Oslo
SLS Postboks 1099
Blindern 0316
Oslo 3, Norway

Gard Brekke
Alf Andersensv 13
3670 Notodden, Norway

Philippines
Milagros Ibe
University of the Philippines
Institute for Science and Mathematics
Education Development
Diliman, Quezon City
Philippines

Ester Ogena
Science Education Institute
Department of Science and Technology
Bicutan, Taquig
Metro Manila 1604, Philippines

Portugal
Gertrudes Amaro
Ministerio da Educacao
Instituto de Inovação Educacional
Rua Artilharia Um 105
1070 Lisboa, Portugal

Romania
Gabriela Noveanu
Institute for Educational Sciences
Evaluation and Forecasting Division
Str. Stirbei Voda 37
70732-Bucharest, Romania

Russian Federation
Galina Kovalyova
The Russian Academy of Education
Institute of General Secondary School
Ul. Pogodinskaya 8
Moscow 119905, Russian Federation

Scotland
Brian Semple
Scottish Office, Education &
Industry Department
Victoria Quay
Edinburgh, E86 6QQ
Scotland

Singapore
Chan Siew Eng
Research and Evaluation Branch
Block A Belvedere Building
Ministry of Education
Kay Siang Road
Singapore 248922

Slovak Republic
Maria Berova
Vladimir Burjan*
SPU-National Institute for Education
Pluhova 8
P.O. Box 26
830 00 Bratislava
Slovak Republic

Slovenia
Marjan Setinc
Pedagoski Institut Pri Univerzi v Ljubljana
Gerbiceva 62, P.O. Box 76
61111 Ljubljana, Slovenia

South Africa
Derek Gray
Human Sciences Research Council
134 Pretorius Street
Private Bag X41
Pretoria 0001, South Africa

Spain
José Antonio Lopez Varona
Instituto Nacional de Calidad y Evaluación
C/San Fernando del Jarama No. 14
28071 Madrid, Spain

Sweden
Ingemar Wedman
Anna Hofslagare
Kjell Gisselberg*
Umeå University
Department of Educational Measurement
S-901 87 Umeå, Sweden

Switzerland
Erich Ramseier
Amt Für Bildungsforschung der
Erziehungsdirektion des Kantons Bern
Sulgeneck Straße 70
Ch-3005 Bern, Switzerland

Thailand
Suwaporn Semheng
Institute for the Promotion of Teaching
Science and Technology
924 Sukhumvit Road
Bangkok 10110, Thailand

United States
William Schmidt
Michigan State University
Department of Educational Psychology
463 Erikson Hall
East Lansing, MI 48824-1034
United States

TIMSS ADVISORY COMMITTEES

The International Study Center was supported in its work by several advisory committees. The International Steering Committee provided guidance to the International Study Director on policy issues and general direction of the study. The TIMSS Technical Advisory Committee provided guidance on issues related to design, sampling, instrument construction, analysis, and reporting, ensuring that the TIMSS methodologies and procedures were technically sound. The Subject Matter Advisory Committee ensured that current thinking in mathematics and science education were addressed by TIMSS, and was instrumental in the development of the TIMSS tests. The Free-Response Item Coding Committee developed the coding rubrics for the free-response items. The Performance Assessment Committee worked with the Performance Assessment Coordinator to develop the TIMSS performance assessment. The Quality Assurance Committee helped to develop the quality assurance program.

INTERNATIONAL STEERING COMMITTEE

Tjeerd Plomp (Chair), the Netherlands
Lars Ingelstam, Sweden
Daniel Levine, United States
Senta Raizen, United States
David Robitaille, Canada
Toshio Sawada, Japan
Benny Suprapto Brotosiswojo, Indonesia
William Schmidt, United States

TECHNICAL ADVISORY COMMITTEE

Raymond Adams, Australia
Pierre Foy, Canada
Andreas Schleicher, Germany
William Schmidt, United States
Trevor Williams, United States

SAMPLING REFEREE

Keith Rust, United States

SUBJECT AREA COORDINATORS

Robert Garden, New Zealand (Mathematics)
Graham Orpwood, Canada (Science)

SPECIAL MATHEMATICS CONSULTANT

Chancey Jones

SUBJECT MATTER ADVISORY COMMITTEE

Svein Lie (Chair), Norway
Antoine Bodin, France
Peter Fensham, Australia
Robert Garden, New Zealand
Geoffrey Howson, England
Curtis McKnight, United States
Graham Orpwood, Canada
Senta Raizen, United States
David Robitaille, Canada
Pinchas Tamir, Israel
Alan Taylor, Canada
Ken Travers, United States
Theo Wubbels, the Netherlands

FREE-RESPONSE ITEM CODING COMMITTEE

Svein Lie (Chair), Norway
Vladimir Burjan, Slovak Republic
Kjell Gisselberg, Sweden
Galina Kovalyova, Russian Federation
Nancy Law, Hong Kong
Josette Le Coq, France
Jan Lokan, Australia
Curtis McKnight, United States
Graham Orpwood, Canada
Senta Raizen, United States
Alan Taylor, Canada
Peter Weng, Denmark
Algirdas Zabulionis, Lithuania

PERFORMANCE ASSESSMENT COMMITTEE

Derek Foxman, England
Robert Garden, New Zealand
Per Morten Kind, Norway
Svein Lie, Norway
Jan Lokan, Australia
Graham Orpwood, Canada

QUALITY CONTROL COMMITTEE

Jules Goodison, United States
Hans Pelgrum, The Netherlands
Ken Ross, Australia

EDITORIAL COMMITTEE

David F. Robitaille (Chair), Canada
Albert Beaton, International Study Director
Paul Black, England
Svein Lie, Norway
Rev. Ben Nebres, Philippines
Judith Torney-Purta, United States
Ken Travers, United States
Theo Wubbels, the Netherlands

Art Direction, Layout, and Cover design by Thomas Hoffmann

Table production by José R. Nieto

TIMSS

BEST COPY AVAILABLE